# Nature

Sir Norman Lockyer

9

# Nature

A WEEKLY

## ILLUSTRATED JOURNAL OF SCIENCE

VOLUME XXXII

MAY 1885 to OCTOBER 1885

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



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# INDEX

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ATURE

ILLUSTRATED JOURNAL OF SCIENCE

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

THURSDAY, MAY 7, 1885 [PRICE SIXPENCE

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## RIBBON METHOD OF CUTTING SECTIONS.

The Cambridge Scientific Instrument Company have designed a new and simple Microtome for cutting continuous Ribbons of Sections on the plan first adopted by Mr Caldwell. The new instrument has the advantage over the original pattern of dispensing with the [illegible] altogether, and consequently not only avoiding the trouble of lifting the [illegible] from the [illegible], but also of allowing them to fall on to the glass slide in their proper position for mounting. Although the instrument costs only [illegible] the price of the original pattern it will be found to do all that is required, and to possess the additional advantage of dispensing with the more complex and less important adjustments. Price of the Microtome, [illegible]

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## LARGE COLLECTION of EXOTIC and

BRITISH WO[illegible] [illegible] Weight, Half a Ton, which obtained W. W. [illegible] Gold Medal at the [illegible] Exhibition [illegible] Beautiful [illegible] [illegible] Skull of a [illegible] Elephant with two [illegible]. Specimens of [illegible] Skulls, Skeletons, [illegible] Apparatus, Shells, Insects, &c.—W. CUTTER, Naturalists' Agent, [illegible] Great Russell Street.

## VICTORIA UNIVERSITY.

The Entrance Examination in Arts (Faculty of Medicine) and the Preliminary Examinations (Faculties of Arts, Science, and Law) will begin on THURSDAY, June [illegible]

Candidates for the Entrance Examination in Arts, if not matriculated, must produce a letter of recommendation from their last instructor and pay a fee of [illegible]. Candidates for the Preliminary Examinations must matriculate before the Examination. The Matriculation Fee is [illegible] and includes the Examination Fee.

Faculties of Arts and Science.—The Intermediate and Final Examinations for Degrees will begin on June [illegible]

Faculty of Law.—The Intermediate and Final Examinations for Degrees will begin on Monday, July [illegible]

Faculty of Medicine.—The Preliminary Examination in Science and the Intermediate M.B. Examinations will begin on Monday, July [illegible] and the First Part of the Final M.B. Examination will begin on Friday, July [illegible]

Further information as to these Examinations can be obtained from the Registrar.

ALFRED T. BENTLEY, M.A., Registrar.

Manchester, May, 188[illegible]

## MUSEUMS AND COLLECTORS.

MR. DAMON, of WEYMOUTH, will forward an abridged Catalogue of his Collections in Natural History Objects, including RECENT SHELLS (Foreign and British), FOSSIL REMAINS, MINERALS, ROCKS, MARINE ZOOLOGY, &c., &c., &c.

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*Geologist, &c.*,
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ATURE

ILLUSTRATED JOURNAL OF SCIENCE

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

...7, 1885

### ...MATICS

*...atics.* By James Gow,
...ress, 1884.)

...f persons who, being
...equire to know some-
...t. The first want only
...uch as can be furnished
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...or which the latter avoids.

...tory of the Mathematical Sciences ...
...843.
... by De Morgan's remarks ...
...s the one who makes a ...
...e may intend to give ...
...es the latter gives a fair index ...
...isfactory' for instance, ...

Mr. Gow's work being upon a special branch, viz. Greek mathematics (which he himself further limits to arithmetic, algebra, and geometry) comes under the second of the above two divisions, though for reasons which are more than once put forward, it is not so thorough a treatise as we could have wished. When, however, we learn that the book "represents part of a collection of notes which I have for many years been making with a view to a general history of the great City of Alexandria," and that "the materials for an account of the Alexandrian Mathematical School grew to exceed the reasonable limits of a chapter," we are glad that Mr. Gow determined to publish his results at an earlier date than he would otherwise have done. What of accuracy or perfection is sacrificed by a perhaps too early publication, he will have, we expect, an early opportunity of making good in a second edition, which we hope will be called for in the near future. It is a great reproach to English mathematicians that such books as this and M. Marie's have hitherto been conspicuous by their absence in this country. We can happily point to papers by De Morgan, to special treatises by Todhunter, to monographs by Allman, and to an interesting *résumé* by Dr. C. Taylor, but we look in vain for anything of the nature of a history of mathematical or physical science in the English language. A tendency of late years to give small historical notices of mathematical discoveries in our school text-books has been displayed, and we trust the time is not far distant when we shall have, if not a great original work, for which we can hardly look, yet a primer or primers founded upon the works of Bretschneider, Cantor, Hankel, Marie, and others.

Almost every page puts in evidence how greatly Mr. Gow is indebted to German and French writers; yet it is also evident, on a perusal of his work, that he is no blind follower of those predecessors in the field: he "calls no one of them master"; but when occasion arises he boldly differs from them, and gives good reasons for so differing. We note here that he does not appear to be acquainted with M. Paul Tannery's work in the same directions as his own. He refers to him but once (p. 101), and then he states he has not been able to find the article (quoted by Cantor). The journal in which the paper is published, viz. *Bulletin des Sciences Math. et Astronomiques*, is an easily accessible one, and we think from the analyses we have from time to time given in these columns of other papers by M. Tannery (in *Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux*) on Greek arithmetic and geometry, our author would have gathered useful material in the *Bulletin* paper and in the *Mémoires* also.[1] But this is the only case of omission we have come across; the reading is apparently most thorough, and the author's Greek scholarship enables him to improve upon the translations given by some of these foreign authorities.

The work consists of three parts. The first part, entitled "Prolegomena to Arithmetic," discusses the decimal scale and Egyptian arithmetic in a very thorough manner. Here, of course, much use is made of the "Rhind papyrus," a book written by one Ahmes (now put at 1700 B.C.), entitled "Directions for Obtaining the Knowledge of all Dark Things," which consists mainly of statements of results. One could wish some safe means could be discovered by the Museum authorities for unfolding the "olden leather-roll on a mathematical subject" which is "apparently too stiff to be opened" (note, p. 16).

There are naturally statements in these early chapters which are fairly open to objection, but they are clearly put, and the results, as Mr. Gow gets them, are summarised on pp. 20, 21.

The second part treats of Greek arithmetic under "Logistica, or Calculation and Arithmetica, or Greek Theory of Numbers." This part is very carefully done, and enables the reader to get a clear idea of the processes employed. Plato's appreciation of *logistic* may be inferred from his direction (Legg. 819) that "free boys shall be taught calculation, a purely childish art, by pleasant sports, with apples, garlands, &c."[2]

The third part treats of Greek geometry, and upon it we could expatiate at some length, but that is hardly our business on the present occasion. We need only say that there is much good work. Dr. Allman's powerful rectification of the position of Eudoxus did not appear in time to be of service to Mr. Gow (he mentions the fact of its publication on p. [illegible] of the Addenda). Most of the geometers appear to have justice done them. We miss some of the touches which appear in M. Marie's work, but again we find a compensation in the fuller account given of Menelaus, and of the proposition now usually cited by the name of that geometer. Chapter V. discusses "prehistoric and Egyptian geometry," in which is given an account of Ahmes' work. Chapter VI. takes "Greek Geometry to Euclid" in five sections. Of the Pythagoreans, the Eudemian summary (which has in previous numbers been referred to in our notices of Dr. Allman's papers) says they made geometry "a liberal education;" and other writers, referred to by Mr. Gow, attribute to them the maxim, "A figure and a stride, not a figure and sixpence gained" (p. 153). In connection with this characteristic maxim we may give the story, which, in the Greek, forms the motto on the title-page of Mr. Gow's book, viz. "A youth who had begun to read geometry with Euclid, when he had learnt the first proposition, inquired 'What do I get by learning these things?' So Euclid called his slave, and said 'Give him threepence, since he must make a gain out of what he learns.'" Many such boys there are, even in this nineteenth century, who are ever asking, "What is the use of learning Euclid?" We thank Mr. Gow for his story from Stobæus, which will possibly make us better prepared to answer the question the next time we are asked it. There is much other quotable matter, but we hasten to a close.[3] Chapter VII. gives an account of Euclid (what little is known of him, his writings, history of text of "Elements," and modern history of the book[4]), Archimedes, and Apollonius. Chapter VIII. is on "Geometry in Second Century B.C.," Chapter IX., "From Geminus to Ptolemy;" and Chapter X., "Lost Years," principally occupied with an account of Pappus and his "Mathematical Collections."

Some matters of interest are illustrated, as the introduction of the *signs* in algebra, of the *sine* in trigonometry: it does not seem to be generally known that the first occurrence of "tangent" and "secant" is traced by De Morgan to a work by T. Finkius, "Geometriæ rotundi libri xiiii," Basileæ, 1583; the derivation of "almagest" (cf. Chaucer's Clerk Nicholas, who had—

> "His almageste and bokes grete and smale,
> His astrelabie, longing for his art,
> His augrim stones, layen faire apart
> On shelves couched at his beddes heed")

and a few others.

On page [illegible] [illegible], for [illegible] read [illegible].

## OUR BOOK SHELF

*The Zoological Record for 1883; being Volume XX. of the Record of Zoological Literature.* Edited by E. C. Rye, F.Z.S., &c. (London: John Van Voorst, 1884.)

ALTHOUGH bearing on its title-page the date 1884, it was not until the end of January in this year that the "Zoological Record for 1883" was in its entire form laid before the public. It comes to us with a melancholy interest, as being the last under the editorship of the late Mr. Rye, whose untimely death we have so recently recorded and deplored. Again in this volume we have to mention still further changes in the staff of the Recorders. Prof. Sollas takes Mr. S. O. Ridley's place as recording the sponges, and Prof. Haddon that of Mr. W. Saville Kent in recording the Protozoa. Other engagements have prevented the Rev. O. P. Cambridge recording the literature of the Arachnida for 1883, and it has been arranged that Mr. T. D. Gibson-Carmichael is to record the literature of this group for 1883 and 1884 in the next volume of the "Record."

A rapid glance over the contents of the volume brings to light the fact that in all the leading groups of the animal kingdom a goodly amount of work has been accom-

[1] In the *Bulletin* for March, 1885, there is a paper by M. Tannery, "Sur l'Arithmétique Pythagoricienne" (pp. 69–88).

[2] It is curious to note that there was a Cocker before Cocker: cf. the Euclidic compliment, "You reckon like Nicomachus of Gerasa"; see also, in the opposite direction, "Budget of Paradoxes," p. 30.

[3] [illegible] of the greatest geometers of antiquity [illegible] "slow and steps" [illegible] There are [illegible] mathematicians who are singularly deficient in [illegible] for any studies but their own."

[4] [illegible] "English Mathematical and Astronomical Writers" [illegible] to "British Almanac for [illegible]" p. [illegible]. De Morgan made one of [illegible] that [illegible] first English Euclid was certainly made from the Greek and not from any of the Arabic-Latin versions. This surmise has been found correct by G. B. Halsted in the *American Journal of Mathematics*, vol. ii. pp. [illegible]. We notice that Mr. Gow gives the same reference in his Addenda. Mr. Gow gives a proof of a prop. [illegible] of Euclid [illegible] which recalls a passage in the recent *brochure* "Flatland": "It is, "If a circle be described in the same plane as the eye, it will seem to be a straight line."

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nk Clowes, D.Sc. Lond.
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afraid he might have ceased to be a chemist. However excellent rules and tables may be in their own way, it is possible to have too much of them. In fact, the better they are the less one wants to be bound by them. The "tables of differences" given in the book are excellent; in the hands of a good teacher they might be made the basis of a really scientific training. But the ordinary student will not trouble to develope methods from the facts set before him in these tables; he will pass on to the systematic examination of simple salts, and be caught in the fatal whirlpool of "experiment," "observation," "inference." M. M. P. M.

*Original Researches in Mineralogy and Chemistry.* By J. Lawrence Smith. Edited by J. B. Marvin. (Louisville, 1884.)

IN a recent number (vol. xxxi. p. 220) we gave a statement of the life and work of the late Prof. J. Lawrence Smith condensed from a memoir prepared at the request of the National Academy of Sciences, Washington, by Prof. B. Silliman, who was so soon to follow his friend to his long rest. The papers containing the original investigations of Prof. L. Smith have now been collected together and reprinted as a memorial volume intended for presentation to his friends. Three memoirs prepared by Mr. Marvin, Mr. Michel, and Prof. Silliman respectively, form an appropriate introduction, and give one a good glimpse into his life and character. The work is clearly printed on good paper, and will be highly appreciated by his numerous friends, to each of whom a copy has been presented by his widow.

*Lehrbuch der Mineralogie.* Von Dr. Gustav Tschermak. Zweite, verbesserte Auflage. (Wien: Alfred Hölder, 1885.)

WE are glad to find that a second edition of this work is already called for, although the latter part of the first edition appeared so lately as 1884. In our notice of the first part of that edition (vol. xxv. p. 355) we directed attention to the excellent character of the work, and gave a brief statement of its contents; we now need only remind our readers that the author is a thorough master of his subject, who has done a large amount of original and valuable work, and further, has had a long teaching experience as Professor of Mineralogy in the University of Vienna. The work is but slightly changed in the present edition; the length is increased by a few pages through the incorporation of the results of investigations made since the first part left the press in 1881: the contents are well up to date. If some University Professor would provide us with an equivalent work written in our own tongue the study of mineralogy in this country would begin to revive.

## 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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### Mr. Lowne on the Morphology of Insects' Eyes

I DESIRE to [illegible] the imputation made by Mr. Lowne in his [illegible] NATURE of April [illegible] 1885, that my opinion with regard to his paper on the structure of the eye [illegible] in Arthropoda was founded on the influence of my colleague, Prof. Lankester, or that any consultation upon the paper took place between [illegible] Referees' reports upon papers for the Royal Society are strictly confidential, and I did not know the name of the [illegible] and I had [illegible] to a conclusion upon the subject [illegible] which [illegible] be made of a long and [illegible] investigation of Mr. Lowne's preparations.

and the nature of which may be inferred from the fact that I advised the author to withdraw his paper and submit the subject to a renewed investigation, with the aid of improved methods.

With regard to the question, which Mr. Lowne raises, as to my competency to form any opinion at all, on the ground that I had not myself devoted any special attention to the literature of the subject, I may remark that the points which had practically to be decided were (1) whether Mr. Lowne's statements were in themselves probable, and (2) whether they were corroborated by his preparations. Had I not felt myself qualified to form an opinion on these points I should not have accepted the reference.

E. A. SCHÄFER

## The Late Prof. Clifford's Papers

IN the "Mathematical Papers" (pp. 628–37) I was able to print the syllabuses of a series of ten lectures delivered by Prof. Clifford to a class of ladies at South Kensington in the spring and summer of 1869. Whilst turning over a collection of miscellaneous papers, in a box, Mrs. Clifford and I had the good fortune to light upon a manuscript quite ready for printing, and this ("Mathematical Papers," p. 625) subsequently formed part of the volume on "Seeing and Thinking;" but we could not find any trace of any more manuscript of the above-mentioned series of lectures. Just before the recent Easter holidays Prof. Karl Pearson returned to me a few pages of manuscript bearing on the International Scientific Series volume which I had lent him, and with them he sent me a large note book which had been in the late Prof. Rowe's hands. On opening this book I at once saw that it contained very full notes of other lectures of the course. In fact, Lecture II. ("On Plane Surfaces and Straight Lines") is quite ready for press, as is also, I think, Lecture III. ("On the Rotation of Plane Figures"); Lecture IV. ("Of Similar Figures") is a fragment, and still more fragmentary is Lecture V. ("The First Principles of Calculation"). Of Lecture VI. ("The Theorem of Pythagoras") there are two loose sheets of figures on one sheet is "the Bride's Chair," and the figures on this and the other sheet show that my information was correct, and that the remarks on pp. 633, 637 are *ad rem*. As Lecture IX. ("On the Shadows of a Circle") is very fully illustrated in the recent volume edited by Prof. Pearson, we see that we are in possession of a fairly complete presentment of Prof. Clifford's views on the subjects of the course of lectures.

Messrs. Macmillan have stated their willingness to publish the MS. of the second part of "The Elements of Dynamics," and I hope to be able, after a re-examination of it, to put the work into their hands for printing. When this book is got out, and the above lectures published in some shape yet to be determined, the mathematical world will be in possession of all that we can now look for from the hands of this great master.

University College School, April 25

R. TUCKER

## Sir Wm. Thomson and Maxwell's Electro-magnetic Theory of Light

SHORTLY after writing my former letter I saw a copy of the verbatim report of Sir Wm. Thomson's lectures in Baltimore, and would have written to you to that effect and to apologise to Mr. Forbes for having doubted the accuracy of what I thought was his report, only that I met him in London about that time, and he then desired me not to do so. Sir William Thomson has now himself stated that the passage is correctly quoted, and I can only regret that he has expressed himself in the way he did.

I certainly think that anybody reading the passage would imagine that the velocity of propagation of electro-magnetic disturbances upon Maxwell's electro-magnetic theory of light, which he showed to be the same as the velocity of propagation of light, and to be a true velocity of wave-propagation—any one, I say, would suppose that this was the same thing as that Sir Wm. Thomson calculated in the year 1854.

Sir Wm. Thomson certainly says, "That is a very different case," but the rest of this sentence is rather ambiguous as to what the "it" after "putting" refers to, and I am afraid that many people will imagine that, in Sir William Thomson's opinion, Maxwell has made some unjustifiable assumption. I believe, however, that all he thinks is that Maxwell has not made a satisfactorily definite thing of the so-called electro-magnetic theory of light.

In Sir Wm. Thomson's article in Nichol's "Cyclopædia" he puts the matter very clearly indeed. He says:—"The of this phenomenon [transmission of electric signals] is iden with that which Fourier . . . found as the law of propaga of summer heat and winter cold to different parts of the ear *i.e.* it obeys the laws of a diffusion and not of a wave-prop tion;" and again:—"Now it is obvious from these re [experimental results] that the supposed velocity of transmis of electric signals is not a definite constant like that of ligh and afterwards he says that, when an initial current is star the potential rises simultaneously at all points, and that apparent velocity would depend on the delicacy of our ins ments. All these obviously distinguish between the propa tion of a variable current in a conductor and a true w propagation.

He has also clearly pointed out a direction in which to l for a true wave-propagation. It will make his position clea and also Maxwell's, to use his analogy between water in elastic tube and a conductor of electricity. I will suppose water contained in a tube bored out of a very large l of india-rubber. He enumerates three electric qualities c cerned, and their hydrodynamic analogues:—(1) "Charge" electrical accumulation in a conductor subjected in any wa the process of electrification. (2) "Electro-magnetic inducti or electromotive force excited in a conductor by variation electric current. (3) Resistance to conduction through a so The hydrodynamic analogues are:—(1) Accumulation o greater or less quantity of water in any part of the canal or tu (2) Inertia of the water. (3) Viscosity or fluid friction. explains that a true wave propagation arises from the compre bility of the water, combined with its inertia, and that if tube be elastic, like india-rubber, there would also arise a wa propagation. "Accordingly," he says, "a definite velocity propagation of electric impulses, depending on the (?) and the capacity for charge, is to be looked for, as has b done in a first article, published by Kirchhoff, on the subjec

Now, in all this discussion Sir Wm. Thomson omits to m tion the only thing that is at all analogous to Maxwell's pro gation of wave disturbances in non-conductors, and it a from his considering the water as contained in a tube ordinary india-rubber tubes, instead of in a tube bored in indefinitely large lump of india-rubber. If we consider case it is evident that one of the conditions to be considere the propagation of waves in this lump of india-rubber. In Wm. Thomson's tube there would of course be a velocity wave propagation in the india-rubber, but that is a very diffe matter from the propagation of disturbances away from neighbourhood of the tube by which energy would be car away from it. To do this Sir Wm. Thomson should have cluded the propagation of sound in the air or whatever he c posed surrounding the outside of his tube. Without inclu this, he was not including anything a bit analogous to Maxw electromagnetic theory of light. In Sir Wm. Thomson's t the whole state of affairs at any time could be expressed in te of variables that represented bodies near the tube, while in other case it would be absolutely necessary to introduce varia representing every part of the india rubber which I have s posed of indefinite extent. This is just the difference betw Sir Wm. Thomson's and Maxwell's views. According to M well's view there is a great deal more going on outside the c ductor than inside it, and it is evident that the inertia of water is a very bad analogue to electromagnetic induction, this latter depends essentially upon the form of the circuit, not only upon its section and length. Maxwell has shown t light may be a wave propagation of what are on his the analogous, though probably utterly unlike the dimensional wa propagated in the india-rubber, and has shown that a medi which would only transmit disturbances analogous to th would explain electric and magnetic phenomena. It is to remembered that Maxwell's theory gets rid of all action a distance, and that the only *experimental* difference between the of action at a distance and of action through a medium is t in this latter case the energy may be propagated in time throu the medium, while in the former it cannot.

I cannot conclude without protesting strongly against Sir W Thomson's speaking of the ether as *like* a jelly. It is in so respects *analogous* to one, but we certainly know a great d too little about it to say that it is *like* one. May be Maxw conceptions as to its structure are not very definite, but neit are any body's as to the actual structure of a jelly, and there no real difficulty in supposing a medium whose condition ws that Maxwell has resenting the condition and magnetic pheno- jelly is at all *like* the much more likely that are changes in structure l displacements of the supposed a necessary risation in terms that her than a change of isplacement" was un- ir Wm. Thomson, not the subject, is lending the ether which is not which may lead to the progress of science as uarded advocacy of the

. FRAS. FITZGERALD

ors

epoch, April 19–20) was usual. The display had ared to have degenerated ving the trouble of ob- the stream gave distinct showed the necessity of riodical showers such as ring a comparatively long of the richness recorded in

Chelmsford, watching for 30m., counted 20 Lyrids mporary radiants of minor rate of apparition on that as high as on any other een able to watch for the 8° + 37°, and remarked that brilliant as first-magnitude very interesting species in

ere obtained in 1883, the of its occurrence; but in arable. On the night of night, 17 Lyrids were ob- ing the last quarter of an ch clouded, and only one computed as 22 for one isplay of 1884 was a notable a clouded sky prevented watched through the morn- ly it may have attained a ears. On the evening of aunted, for in a watch of star appeared, though the

curred under very auspicious no impediment to morning time to watch for these Lyræ, is very low in the 17, 18, 19, and 20 were ree latter dates observations esults:—

| Meteors seen | Lyrids seen | Radiant Point |
|---|---|---|
| [illegible] | 6 | [illegible] |
| 18 | 10 | [illegible] |
| 26 | 14 | [illegible] |
| [illegible] | [illegible] | [illegible] |

ly weather effectually pre-

interesting facts. It shows portion of Lyrids to uncon- the same, namely, at 3 to 5; apparition was little more than placement of the radiant in

the direction of east longitude) from night to night. I regard this as the most interesting and certain feature observed. The three centres resulting from the paths of short meteors, observed with the utmost care, may each be relied on as very accurate. It therefore appears most conclusive that the radiant point of the Lyrids, similar to that of the August Perseids, increases in right ascension from night to night, and the extent of this displacement is even greater for the Lyrids than for the Perseids.

On April 19, 1884, 11½h., I found the radiant at 269° + 33°, and on April 19, 1885, 12¼h. (the middle time of the observations), at 267½ + 33°. Allowing for the difference (about 12°) in the sun's longitude at the two epochs in applying the correction for the displacement of the radiant (7° of R.A. daily) observed this year, we shall find that the two positions are in *exact* agreement.

The recent display has been decidedly meagre in point of numbers. There is a great falling off since last year, when the hourly rate was nearly eight times as great. But some of the meteors observed this year were very bright and in a great measure compensated for their scanty apparitions. It is curious that three of the most brilliant Lyrids, equal to or exceeding Jupiter, appeared in nearly the same region of the western boundaries of Virgo. On April 18, at 12h. 57m., one of these fell, with a bright flash and streak, 10° east of Spica Virginis. Another on April 20, at 13h. 14m., came out very suddenly 7° above that star; and a third, at 14h. 1m., descended, with a swift, diving motion, about 13° east of the star, so that the path was nearly similar to that of the first of the three. These fire meteors gave transient

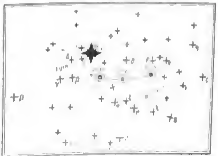

Diagram exhibiting the displacement of the radiant point among the stars of Hercules and Lyra on the nights of April 18, [illegible]

flashes of yellowish-white light, which brightly illumined the mist lying along the horizon, and left short streaks of very brief duration. I saw four other Lyrids, quite equal to first magnitude stars, and these, together with the fainter members of the same shower, were nearly all registered amongst the stars surrounding [illegible], especially those of Hercules, Draco, and Aquila. Alto- gether I regard the April display of this year as one of con- siderable importance, for though much less rich than in 1884, it furnished meteors of greater interest and brilliancy. The low position of the radiant during observations last year may have influenced the visible aspect of the meteors from Lyra, especially as regards the swift, flashing characteristic so invariably noticed this year in the brighter members, or, possibly, the explanation may be that near the richer portion of the stream the corpuscles are smaller in almost the same ratio as the increased condensa- tion. It will be advisable to regard this question during future observations of this shower, and especially the new feature detected this year as to the [illegible] shifting of the radiant point from night to night. I believe the [illegible] of the shower is usually [illegible] with the radiant at 269½ + 33°, the radiant [illegible] (1861 to 270½ + 32°). If the display [illegible] extends over a long [illegible] days, and the radiant shifts 7° in R.A. every day, [illegible] that the meteors will be *Herculids* [illegible] April 17, 18, [illegible] *Lyrids* on April 20, 21, 22, and 23, and on April 24.

[illegible] contemporary with the special periodical display of this epoch there are vast numbers of feeble systems which annually give some indication of their presence. This year I ascertained the positions of several of these showers with great care. The number of meteors from them averaged from 3 to 5 only, but the paths intersect nearly at a point in the individual cases, so that the centres are entitled to the same value as positions resulting from a large number of tracks. I give the best of these co-Lyrid showers, and the nearest confirmations from previous observations:—

| Observed 1883 | Previous Observations | Authority |
| --- | --- | --- |
| April 18 ... 282 + 35½ | ... 284 + 35 | ... March 31 April 11, D.S., 1877 |
| 19 ... 276 + 60 | ... 291 + 55 | ... April 14, Schiaparelli and Zezioli |
| 20 ... 268 + 41 | ... 263 + 42 | ... March 12 April 30, Greg and Herschel |
| 18-21 ... 296 ± 0 | ... 294 ± 0 | ... April 16-19, 1877, D |
| 19-20 ... 230 + 27 | ... 230 + 26 | ... April 22-24, Heis |
| 18-20 ... 266 + 24 | ... 268 + 23 | ... April 16-19, 1877, D |
| | 260 + 20 | ... April May, Corder |
| 18-20 ... 213 + 9 | ... 216 + 15 | ... April 25 May 11, Heis |
| 21-20 ... 268 ± 0 | ... 266 [illegible] | ... April 18-19, 1877, D |

The two radiants observed here in 1877 and 1883, with mean position at 295° ± 0° and 268°·5 + 24°·5, are very interesting. The former, just preceding a Aquilæ on the equator, supplies meteors of very great velocity, the latter in Vulpecula gives swift, streak-leaving meteors. This pair of showers, directed from points near the apex of the earth's way, are now, I believe, very exactly determined in regard to their centres of radiation. That they have hitherto evaded frequent detection is not surprising, as they only become well visible in the morning hours. It will be useful to watch for these special streams during future exhibitions of the Lyrids, as well as to note the several other interesting features closely associated with this well-known display.

W. F. DENNING

## Chinese Insect Wax

THE beetle alluded to in connection with this subject in the last number of NATURE (vol. xxx. p. 615) is a probably undescribed species of *Brachytarsus*, a genus of the family *Anthribidæ*, allied to the *Curculionidæ*. Through the courtesy of the authorities at Kew I have had specimens before me. The idea that it acts as a sort of midwife to assist at the birth of infant *Coccidæ* is quite erroneous. The genus *Brachytarsus* is a true parasite on *Coccus*, and its habits, in this connection, in Europe, have long been known. It is of course interesting to find "unity of habit" prevailing in the case of *Coccus Pela*, even to its parasite; but with regard to the latter there is nothing new; some points in the general economy of the wax insect, in the notes published, are of far greater importance.

Lewisham, May 1 R. MCLACHLAN

## The New Bird in Natal

THERE can be little doubt from the description given by Mr. Turnbull in your issue of April 26 (p. 554) that the bird lately obtained by him in Natal is the Standard-winged Nightjar, *Cosmetornis* (seu *Macrodipteryx*) *vexillarius*, Gould. It has not been met with in Cape Colony, which accounts for Mr. Turnbull's inability to find mention of it in Layard's "Birds of South Africa;" but in Mr. Sharpe's new edition of Layard's work (which Mr. Turnbull would do well to procure) he will find an account of this bird given at p. 89. It appears to have a wide geographical range, being found both on the west and east coasts of Africa; in Angola and Damaraland, in Natal, on the Zambesi (where 300 miles up the river Dr. Kirk found it quite common), in the islands of Bourbon and Madagascar, along the Red Sea shore, and on the island of Socotra. With this extended range it is somewhat remarkable that it has not yet been met with in Cape Colony. According to the observations of Dr. Kirk the singular prolongations of the primaries are peculiar to the males, and a seasonal peculiarity observed only during the months from October until January. The habits of this bird, like those of other nightjars, are crepuscular. An excellent coloured figure of the male is given in Gould's "Icones Avium."

J. E. HARTING

## Wild Bees

A FEW words respecting a colony of wild bees (a species of *Andrena*) which I have just discovered in our garden, may interest your entomological readers. A day or two ago, on walking beside a low-turfed mound which supports two trees on one of our towns, I noticed that the grassy surface on the —therefore the sunny—side was covered with little hilloc earth, such as ants throw up after rain. On examination little heap showed the circular hole which denotes a bee's and the bees themselves were seen in many places going in out. Some holes were level with the ground, but most hav tiny mound of soil cast up in the process of excavation. peculiarity of the case seems to me to lie in the great numb nests forming a complete colony. It is difficult to count t but there cannot be less than eighty or ninety in an a roughly calculated—of about sixty square feet. Have an your readers noticed a similar city of these busy people i can any one supply the specific name? E. BROV

Farther Barton, Cirencester, May 2

## ON M. WOLF'S MODIFICATION OF FO AULT'S APPARATUS FOR THE MEASU MENT OF THE VELOCITY OF LIGHT

NO one who has the true interests of scientific a racy at heart can fail to welcome any innov whereby the elements of a research may be varied thereby the ever lurking constant error is most re eliminated. It seems, therefore, that this in itse sufficient reason for the interesting paper communic by M. Wolf to the Académie des Sciences (*Com Rendus*, 9 Février), describing a very ingenious arra ment of Foucault's experiment, and that there wa occasion for disparaging other work in order to ju its publication. It is to be hoped that this was rather through inadvertence than design, but I feel c upon to correct some of the misapprehensions w which the author labours, and particularly those conc ing the appearance and distinctness of the image o slit in my work on the velocity of light.

M. Wolf remarks that, under the conditions whi selected, this image, even under the most favourable cumstances, must be bordered with very large diffra fringes, which the atmospheric disturbances trans into a badly-defined "*tache lumineuse*." In reply to though I grant that the fringes *ought* to be present, can affirm as a matter of fact that they were not t seen. Possibly M. Wolf and others may have somewhat misled by a drawing of the appearance o image given in my work (p. 124, *Astr. Papers, Amer Ephemeris, and Nautical Almanac*, vol. i. Part 3) wher image proper, which is quite clear, is surrounded luminous haze, from which, however, it is very e distinguished.

I hardly think that if M. Wolf had given the "speci observations" (p. 133 of my work) due consideratio would have characterised as a "*tache lumineuse* image whose position was measured with the follo results (each result is the mean of ten observations m by one observer, and recorded without divulging the r by another):—

| | | |
| --- | --- | --- |
| No. 1 | 112·801 mm. | 0·021 mm. |
| " 2 | 112·773 " | 0·006 " |
| " 3 | 112·769 " | 0·010 " |
| " 4 | 112·772 " | 0·007 " |
| " 5 | 112·779 " | 0·000 " |

Average difference from mean = 0·0086 "

These are measurements of the *deflected* image, so the differences are not merely errors of linear meas ment, but include errors in the estimate of the spee the revolving mirror.

Now, M. Wolf, in his most sanguine statement, not hope for a greater degree of accuracy than one in 3500 in this particular measurement, whereas above results are on the average closer than one par 10,000.

But let us examine the data on which he bases

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perhaps one in 1000."
ERT A. MICHELSON

*ATION TO CERTAIN*
*MR. WILLOUGHBY*
*DETERMINATION*

Willoughby Smith before
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ks upon Mr. Willoughby
carry weight correspond-
the author in this branch

ents a primary circuit is

arranged in connection with a battery and interrupter, and a secondary circuit in connection with a galvanometer and commutator of such a character that the make and break induced currents pass in the same direction through the instrument. Under these circumstances it is found that at high speeds the insertion of a copper plate between the primary and secondary spirals entails a notable diminution in the galvanometer deflection, and this result is regarded as an indication that the molecules of copper need to be polarised by the lines of force—an operation for which there is not time at the higher speeds. The orthodox explanation of the experiment would be that currents are developed by induction in the copper sheet, which thus screens the secondary spiral from the action of the primary, and the result is exactly what might have been anticipated from known electrical principles. I have the less hesitation in saying this, because as a matter of fact I did anticipate from theory the action of a combination very similar in character. The experiment is described in the *Philosophical Magazine* for May, 1882, and differs from Mr. W. Smith's only in the substitution of a telephone for the galvanometer, and of a microphone for the interruptor, no reverser in the secondary circuit being required. By the interposition of a thick copper sheet the sound is greatly enfeebled.

The second series of experiments were made with Faraday's "new magneto-electric machine," in which a copper disk rotates about its centre between the poles of a horse-shoe magnet. The currents developed are examined with a galvanometer whose electrodes touch two points upon the disk—in Mr. W. Smith's experiments, one at the centre, and the other at the circumference. At low speeds the distribution is symmetrical with respect to that diameter of the disk which is passing at any moment between the poles; but, as the speed is increased, a certain "drag" is observed, disturbing the symmetry. This drag, or lagging, was noticed by Nobili in a very similar arrangement as long ago as 1833 ("Wiedemann's Electricity," third edition, vol. iv., § 374), and is no doubt to be attributed to the induction of the currents upon themselves.

This question of self-induction is indeed a very important one in respect of certain methods for determining the ohm, but it certainly cannot be said to have been neglected, as Mr. W. Smith seems to suggest. Both in the original experiments of the British Association Committee with a coil revolving about a vertical axis, and in my own recent repetition of them, the self-induction of the coil is a most important feature, and may cause a displacement of the position of maximum current from the plane of the magnetic meridian through as much as 20°. In my paper (*Phil. Trans.*, 1882, p. 661) I thought I had discussed the question at almost tedious length.

It is possible that Mr. W. Smith had in his mind rather determinations by the method of Lorenz, in which Faraday's disk is used. The arrangement here, however, differs in one very important respect from that of Mr. W. Smith's experiments in that the lines of force are symmetrically arranged in relation to the axis of rotation. The consequence is that, however great the speed of rotation, there are no currents flowing in the disk, and therefore no question arises as to the self-induction of such currents. What is observed is simply the difference of electrical potential between the centre and the circumference. It is impossible to discuss the matter fully here, but the reader will find all that is necessary by way of explanation in the paper published in the *Phil. Trans.* ("Experiments by the Method of Lorenz for the further Determination of the Absolute Value of the British Association Unit of Resistance," &c.). My object in writing is to correct the inference, suggested by [illegible] W. Smith's remarks, that the question of self-induction has been neglected by workers upon this subject.

RAYLEIGH

## THE INVENTIONS EXHIBITION

IN the presence of a crowded and distinguished assembly the Inventions Exhibitino was opened by the Prince of Wales on Monday. The Exhibition is, as usual on first days, still in a somewhat chaotic condition, and we can do no more this week than refer to the leading incidents of the opening ceremony. Sir Frederick Bramwell, Chairman of the Executive Council, in his address to the Prince of Wales, gave a sketch of the progress and objects of the Exhibition, which, he pointed out, is intended to illustrate the progress of inventions since the year 1862, and that of musical instruments and appliances since the commencement of the present century. The labours of the different committees were, he stated, rendered extremely onerous by the vast number of applications received—a number far greater than we had space to accommodate. Influential Commissions have beeo nominated by Austria-Hungary, France, China, Greece, Italy, Japan, Russia, Siam, and Switzerland, from which countries interesting and valuable exhibits have been received or are promised. Arrangements have been made with the Council of the Royal Albert Hall by which that building forms an integral portion of the Exhibition, with the National Fish Culture Association for the maintenance of the Aquarium, and with the Council of the Royal Horticultural Society for the holding of the usual periodical flower and fruit shows. The Old London Street, which was so popular a feature in last year's Exhibition, has been maintained. Many small annexes have been swept away, and in their places spacious galleries have been erected. Not only has greater exhibiting space been thus obtained, but the gardens, which are so great a source of attraction to visitors, have actually been enlarged. Notwithstanding the fact that the gallery used last year for machinery has been greatly extended to meet the requirements of exhibitors, it proved to be inadequate for the many important inventions for which motive power was desired; indeed, it has been found necessary to furnish such power in no less than three other galleries. "The employment of electricity for the purposes of lighting," Sir Frederick said, "is undoubtedly one of the most striking instances of the application of science to the purposes of daily life: we have, therefore, not hesitated to give this subject special prominence. The method we have adopted will, it is believed, render any sudden failure of the lights impossible, and will favourably display the most recent and improved apparatus, and the advances that up to this date have been made in electric lighting. After most careful experiments we have ventured to employ, for the garden illumination, the incandescent electric lamp, and we have done so in a manner aod on o scale which, we believe, has never before been attempted. As a division of the Exhibition is devoted to music, we have set apart an important portion of the buildings to the illustration of instruments and appliances appertaining to that art, and we have invited the formation of a historical loan collection of musical instruments, which we believe is of a deeply interesting character. In requesting your Royal Highness to declare this Exhibition open we desire to express the hope that it may, on the one hand, be the means of bringing valuable and meritorious inventions prominently before the general public, to the benefit and credit of the exhibitors, and that it may, on the other hand, be the means by which that public may, within the area of one exhibition, be enabled to appreciate the marvellous progress which during the past quarter of a century every industry has achieved."

The Prince of Wales, in reply said: It is with much pleasure that I have listened to the report of the Executive Council, and I fully appreciate the labours which you have bestowed upon this great undertaking. At the closing of the International Fisheries Exhibition I took the opportunity of expressing a hope that ao International Inventions Exhibition might be held in these buildings during the present year; and I am sincerely gratified to find that this hope has been realised. The scope of thia Exhibition is, indeed, vast, and I can readily comprehend the difficulties which must have beset you and the Committee of Advice in your endeavours to secure adequate representation for each branch of industry. I have observed with much pleasure that the classification originally adopted has been made the practical basis of the allotment of space in the Exhibition, and that the exhibits in each group have, as far as possible, been placed together. I am convinced that by following this plan you have materially increased the educational value of the Exhibition. I readily echo the sentiments of gratitude which you have expressed for the invaluable aid rendered by the guarantors; and I join with you in welcoming the representatives of those foreign countries who are present here to-day.

The Prince of Wales, after declaring the Exhibition open, made a tour of the galleries in company with the Princess of Wales and maoy others of the distinguished visitors who were present.

## THE FLORA OF BANK-NOTES

"LA Flore des Billets de Banque" is the title of an article in *Science et Nature*, an article which, io spite of an amusing tendency inseparable from all things savouring of sensational science, may suggest thoughts more or less alarming in view of recent discoveries in bacteriology. It is no new fact that books, coins, and other articles of a durable nature which pass much from hand to hand may be the means of transmitting


infectious diseases, and if these infectious diseases are caused by visible and tangible agents, it is not going far to expect that the agents should be discoverable on the transmitting media by means of the microscope, and by other methods employed by the specialists who devote themselves to tracing the awful bacterium to its home. Of course it is now matter of fact that "bacteria" (using the term in its widest sense) can be and are causal agents in disease, and the writer of the article referred to shows that bacteria and other minute organisms always occur on bank-notes; there is, perhaps, no more in this observation than that it demonstrates a fact in a particular case

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servations will be made use of to bring more forcibly before the minds of our less careful brethren the dangers of handling "filthy lucre" in times of disease.

## STANDARD PITCH[1]

M. SORET raises the question of musical pitch, and advocates A 432, long ago proposed by M. Meerens, of Belgium. It is rather curious that in Belgium itself M. Meerens's proposal was considered and rejected by a Commission appointed in 1877, upon whose report the French pitch A 435 was adopted by Royal decree on March 19 of this year. There seems to be very little difference between the two; it amounts, in fact, to exactly 12 cents or hundredths of an equal semitone, of which 21½ make a comma. Hence there is no practical reason for making the change as affecting singers. But no instruments made for A 435 would be available for A 432, so that the advantage of uniformity would be lost, without any advantage to the voice or the quality of instruments. The arguments in its favour are almost entirely arithmetical. To begin with the inaudible 1 vibration and proceed by exact doubling to 64 is an arithmetical dream. It is true that König, by a most ingenious adaptation of a large tuning-fork acting in place of a pendulum to a clock going in a room at 20° C. (for about five days in a year), has succeeded in making a fork of that precise number of vibrations at that precise temperature. But at 15° C., the temperature adopted for the French *diapason normal* (standard fork), the pitch of this would not be 64, but, to take König's numbers, 64·036. The charm of the arithmetic vanishes, therefore, with a slight alteration of temperature, and the pitch has become fully 1 cent (hundredth of a semitone) sharper. Granted that this is an imperceptible amount, yet it is enough to alter the whole of the arithmetic. Then the arithmetic is itself founded on just intonation, which is not adopted anywhere. If we take the equal temperament, now generally accepted, we should get for A 432 the values C 256·9, C♯ 272·2, D 288·3, D♯ 305·5, E 323·6, F 342·9, F♯ 363·3, G 384·9, G♯ 407·8, A 432, A♯ 457·7, B 473·9, C 513·8. There is nothing charming here. M. Soret, in his table, quietly ignores the chromatic notes and the equal temperament. If, however, we took C 256 as the starting-point, the A of C major in just intonation would not be 432, but, as he owns, a comma flatter, 426·67. He bases everything physically on the violin, which is tuned in D and not in C, on the viola and violoncello, which are both tuned in G, not in C, and hence even for these instruments, with the great assumption of just intonation, his use of the major scale of C is incorrect.[2] The reasons that are to guide us in the choice of a pitch must certainly not be arithmetical. For more than two centuries up to 1813, when the Philharmonic Society was founded, all Europe used a pitch within a comma either way of Handel's fork A 422·5. Then, owing to the presentation of new instruments by the Emperor of Russia to a Vienna regiment at the Congress of Vienna, pitch rose gradually but slowly. In 1826 our Philharmonic Society, under Sir G. Smart, adopted A 433, between M. Soret's and French pitch, and this was known for many years in London as the Philharmonic pitch. France adopted A 435 in 1859. Under Costa our pitch rose to its present height, A 454·7. But our army pitch, used at Kneller Hall and adopted for the forthcoming Exhibition, is A 452. Now, the trouble is that our classical composers wrote their music for Handel's pitch, while since 1820 Continental composers

[1] J. L. Soret, "Sur le Diapason." ... *des Sciences Physiques et Naturelles* ... [illegible]

[2] [illegible] ... the pitch of ... A series of ... gave about 750 as the ... of Musical Pitch.

have used French pitch, and English composers our high pitch. The first and last may compromise with the second, but are incompatible with each other. To sing Handel in modern English pitch is to unduly strain voices and spoil the effect originally intended. But we submit to it even in Handel festivals. There is a greater difficulty in altering pitch in England than on the Continent. We have no subsidised Conservatoires or theatres to which we can say: "Use this standard of pitch, or go without subsidy." Even regimental bands are not supplied at the expense of the State. A new set of instruments is very costly, and more than that, it is long before makers learn how to manufacture correctly to a new pitch. The question is therefore beset with difficulties. But the solution is certainly not to be found in the arithmetic of M. Soret.

## *THE SCIENCE AND ART MUSEUM, EDINBURGH*

WE understand that Col. Murdoch Smith has been appointed by the Lords of the Committee of Council on Education to the Directorship of this Museum, in succession to the late Prof. Archer. As Lieut. Smith he was associated with Prof. Newton in the discoveries at Halicarnassus, and, subsequently, with Commander Porcher, R.N., undertook the explorations in the Cyrenaica which resulted in the acquisition by the nation of the valuable collection of sculptures now in the British Museum. Latterly, Col. Smith, while employed at Teheran, has acquired for the South Kensington Museum the large and valuable collection of Persian art and manufactures which is so well known there. We believe Col. Smith obtained his first Commission in the Royal Engineers direct from a Scottish University, and is one of the very few officers in that Corps who did not pass through the Royal Military Academy at Woolwich or Addiscombe.

## *NOTES*

We take the following from the *Times*:—The following is the list of selected candidates recommended by the Council of the Royal Society for the election to the Fellowship:—A. W. Baird, Major R.E., P. Herbert Carpenter, D.Sc., Sir Andrew Clark, M.D., Mr. A. A. Common, F.R.A.S., E. W. Creak, Staff-Commander, R.N., Prof. E. Peters, H. Hicks, M.D., W. M. Hicks, M.A., F. R. Japp, Ph.D., A. M. Marshall, M.D., Prof. H. N. Martin, D.Sc., C. O'Sullivan, Prof. J. Perry, Prof. Sydney Ringer, and Sidney H. Vines, D.Sc.

Of the fifteen candidates who have thus been selected no less than five are Cambridge men. Mr. W. M. Hicks was bracketed seventh wrangler in the Mathematical Tripos of 1873. Prof. H. N. Martin, Prof. Milnes Marshall, and Dr. Vines were the seniors in the Natural Science Triposes of 1873, 1874, and 1875 respectively, while Dr. Herbert Carpenter obtained a First Class in the Tripos of 1874, together with Mr. J. N. Langley, who was elected to the Royal Society in 1883. The name of the late Prof. F. M. Balfour follows that of Dr. Martin in the Tripos list of 1873; while the late Prof. A. H. Garrod was senior in 1871, and the Tripos list of 1870 contains the names of Francis Darwin and E. J. Romanes. The Natural Science Triposes from 1870 to 1875, inclusive, have thus furnished no less than nine Fellows of the Royal Society, either actual or elect. The names of seven more occur in the Mathematical Tripos lists from 1871 to 1880 inclusive, viz.: J. Hopkinson (1871), J. W. L. Glaisher (1871), H. Lamb (1872), A. B. Kempe (1872), W. M. Hicks (1873), Rev. T. Glazebrook (1876), and J. J. Thomson (1880). To these may be added the name of Dr. W. H. Gaskell, who obtained mathematical honours in 1869, but has since devoted himself to physiology. All ... know Cambridge will recognise how largely these results ... due to the influence and example of the late Prof. Clerk Max... and of Prof. Michael Foster respectively.

We are informed that Dr. Frankland, F.R.S., has announ... his intention to resign the Professorship in Chemistry in ... Normal School of Science and Royal School of Mines at ... end of the current session. Applications for the post should ... addressed to the Secretary, Science and Art Department.

The Fifty-fifth Annual Meeting of the British Association ... commence on Wednesday, September 9, 1885, at Aberde... The President Elect is the Right Hon. Sir Lyon Playfair, K.C... M.P., Ph.D., LL.D., F.R.S. L. & E., F.C.S., who will t... the place of Lord Rayleigh. The Vice-Presidents are His Gr... the Duke of Richmond and Gordon, K.G., Chancellor of ... University of Aberdeen, the Right Hon. the Earl of Aberde... LL.D., Lord-Lieutenant of Aberdeenshire, the Right Hon. ... Earl of Crawford and Balcarres, F.R.S., James Matthews, L... Provost of the City of Aberdeen, Prof. Sir William Thoms... F.R.S., Alexander Bain, M.A., LL.D., Rector of the Univer... of Aberdeen, the Very Rev. Principal Pirie, D.D., Vice-Cha... cellor of the University of Aberdeen, Prof. W. H. Flow... F.R.S., Pres.Z.S., Director of the Natural History Muse... General Treasurer: Prof. A. W. Williamson, F.R.S., Univers... College, London, W.C. General Secretaries: Capt. Doug... Galton, C.B., F.R.S., A. G. Vernon Harcourt, F.R.S. Secr... tary: Prof. T. G. Bonney, F.R.S. Local Secretaries for ... meeting at Aberdeen: J. W. Crombie, M.A., Angus Fra... M.A., M.D., Prof. G. Pirie, M.A. Local Treasurers for ... Meeting at Aberdeen: John Findlater, Robert Lumsden. T... Sectional Officers are as follows:—A. Mathematical and Ph... ical Science. President: Prof. G. Chrystal, M.A., F.R.S... Vice-Presidents: Prof. C. Niven, F.R.S., Prof. A. Schust... F.R.S. Secretaries: R. E. Baynes, M.A., R. T. Glazebro... F.R.S., Prof. W. M. Hicks, M.A. (Recorder), Prof. W. Ingra... M.A. B. Chemical Science. President: Prof. H. E. Ar... strong, F.R.S. Vice-Presidents: Prof. A. Crum Brow... F.R.S., Prof. H. McLeod, F.R.S. Secretaries: Prof. ... Phillips Bedson, D.Sc., F.C.S. (Recorder), H. B. Dixon, M... F.C.S., H. Forster Morley, D.Sc., F.C.S., W. J. Simpso... M.D. C. Geology. President: Prof. J. W. Judd, F.R... Sec.G.S. Vice-Presidents: John Evans, Treas.R.S., Pr... W. C. Williamson, F.R.S. Secretaries: C. E. De Ran... F.G.S., J. Horne, F.R.S.E., J. J. H. Teall, M.A., F.G... W. Topley, F.G.S. (Recorder). D. Biology. President: Pr... W. C. McIntosh, F.R.S. Vice-Presidents: Prof. I. Bay... Balfour, F.R.S., Prof. J. S. Burdon Sanderson, F.R... Secretaries: W. Heape, J. Duncan Matthews, F.R.S.E... Howard Saunders, F.L.S., F.Z.S. (Recorder), H. Marsh... Ward, M.A. E. Geography. President: Lieut.-General J. ... Walker, C.B., R.E., F.R.S., F.R.G.S. Vice-Presidents: Pr... James Donaldson, F.R.S.E., John Rae, M.D., F.R.S. Secr... taries: J. S. Keltie, F.R.G.S., J. S. O'Halloran, F.R.G.S... E. G. Ravenstein, F.R.G.S. (Recorder), Rev. ... A. Smit... F. Economic Science and Statistics. President: Prof. Hen... Sidgwick, M.A., Litt.D. Vice-Presidents: Prof. R. Adamso... M.A., LL.D., Sir Rawson W. Rawson, K.C.M.G., C.B... Pres.S.S. Secretaries: Rev. W. Cunningham, B.Sc., F.S.S... Prof. H. S. Foxwell, F.S.S. (Recorder), C. McCombie, M... J. F. Moss, F.R.G.S. G. Mechanical Science. Presiden... Benjamin Baker, M.Inst.C.E. Vice-Presidents: Prof. W. ... Unwin, M.Inst.C.E., Prof. H. C. Fleeming Jenkin, F.R.S... M.Inst.C.E. Secretaries: A. T. Atchison, M.A., M.Inst.C... (Recorder), F. G. Ogilvie, M.A., E. Rigg, M.A., H. T. Wo... M.A. H. Anthropology. President: Francis Galton, F.R.S... President of the Anthropological Institute. Vice-Presidents:

W. Pengelly, F.R.S., Prof. W. Turner, F.R.S. Secretaries: G. W. Bloxam, F.L.S. (Recorder), J. G. Garson, M.D., Walter Hurst, B.Sc., A. MacGregor, M.B. The First General Meeting will be held on Wednesday, September 9, at 8 p.m. precisely, when the Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., F.R.S., F.R.A.S., F.R.G.S., will resign the chair, and the Right Hon. Sir Lyon Playfair, K.C.B., M.P., Ph.D., LL.D., F.R.S. L. & E., F.C.S., President-Elect, will assume the Presidency, and deliver an address. On Thursday evening, September 10, at 8 p.m., there will be a Soirée; on Friday evening, September 11, at 8.30 p.m., a discourse by Prof. W. Grylls Adams, M.A., F.R.S., F.G.S.; on Monday evening, September 14, at 8.30 p.m., a discourse on "The Great Ocean Basins," by John Murray, F.R.S.E., Director of the *Challenger* Expedition Commission; on Tuesday evening, September 15, at 8 p.m., a Soirée; on Wednesday, September 16, the concluding General Meeting will be held at 2.30 p.m. The lecture to working men will be on the "Nature of Explosions," by Mr. H. B. Dixon, M.A., F.C.S., Fellow of Trinity College, Oxford.

We understand that the Marquis of Lorne is likely to succeed Lord Aberdare as President of the Royal Geographical Society.

Sir John Lubbock responded to the toast of "Science" at the Royal Academy dinner on Saturday evening, and in doing so adduced one more argument on behalf of science as a training and discipline even from the standpoint of art. He claimed for the workers in science that the careful habit of observation and study in which they are necessarily trained enable them to derive peculiar enjoyment from the creations of artistic genius; and he might have suggested in this connection the great advantage to the artist himself of a preliminary training in practical scientific work.

Sir Frederick Bramwell has evidently a very high ideal of the training necessary to qualify a civil engineer for the performance of the duties of his calling. At the anniversary dinner last week he told his audience that the ideal engineer—"I am glad to say in many cases the real engineer—of the present day is one who has a scientific knowledge as the foundation for his technical training, and frequently that scientific knowledge is of a very extended character. Mechanics, it need hardly be said, are essential, but, in addition, many branches of physical science, such as heat, light, sound, hydraulics, pneumatics, magnetism, electricity, are all now within the knowledge of the accomplished engineer. Moreover, although I do not suggest that every engineer should be a chemist, it is quite certain that he should not be without some chemical instruction, even if it be confined to that which is needed to warn him that the time has arrived when he should seek sound chemical advice."

Dr. Noetling, of the University of Königsberg, has been despatched by the Prussian Academy of Sciences to Lebanon, to study the geology of the Greater Hermon.

The Italians have lost no time in erecting a meteorological station at Massowah, which they have occupied quite recently.

Early in the afternoon of the 2nd a loud detonation was heard from Mount Vesuvius, and two new craters, from which lava issued abundantly, were opened on the southern side at a height of about 200 metres above the upper station of the funicular railway. The lava flowed in the direction of Pompeii and Torre del Greco. The stream descends in a straight line for about half a kilometre, and then, turning sideways, is directed towards the crater of 1872. The new craters present the appearance of a great cleft. The lava has not spread beyond the side of the mountain, and according to the latest telegram the eruption is not increasing.

At half-past 1 o'clock on the morning of the 1st inst. two or three rather violent shocks of earthquake were felt at Vienna, accompanied by a rolling noise, and causing a great clattering of furniture. Shocks of far greater violence were experienced in Styria, where many houses were damaged and some persons were killed. In the western districts the shocks were of a slight character. The phenomenon appears to have extended southward as far as Grätz and westward to Bavaria. A shock was also felt at Monte Carlo at 10 minutes to 3 on the morning of the 2nd. The shock was strongest in the districts of Condamone and the Cap d'Aile.

The Annual General Meeting of the members of the Iron and Steel Institute commenced yesterday. The Bessemer medal for the year was presented to Prof. Richard Åkermann by Dr. Percy, F.R.S., the newly-elected President, who gave his inaugural address. The meeting will be continued to-day and to-morrow. The following is a list of some of the principal papers:—On the blast furnace value of coke from which the products of distillation have been collected, by Mr. I. Lowthian Bell, F.R.S.; on the manufacture of steel, by Sir Henry Bessemer, F.R.S.; on the mechanical properties of steel, by Dr. H. Wedding; on the microscopic structure of steel, by Dr. Sorby; on the causes of failures in steel plates, by Mr. W. Parker, of Lloyd's; on a new description of wrought-iron castings, by Mr. T. Nordenfelt; on natural gas, and its utilisation for manufacturing purposes in the United States, by Mr. A. Carnegie; on a modified type of the Siemens gas-producer, whereby the gases are enriched and the bye-products recovered, by Mr. J. Head. We propose to draw attention to the scientific points in some of these papers next week.

Prof. W. Odling will give the first of two lectures on Organic Septics and Antiseptics, at the Royal Institution, on Saturday, May 16.

There is an excellent programme for May at the Royal Victoria Hall and Coffee Tavern, Waterloo Bridge Road, S.E. The science lectures on Tuesdays will be given by Dr. Dallinger, on wonderful things we do not personally see, on the 12th; and by Prof. Perry on the spinning tops of Japan and other countries, on the 19th. Owing to the depression in trade and wishing to put enjoyable entertainments within every one's means, the management have decided to lower the prices of admission during May.

The Russian Geographical Society has awarded, this year, its great Constantine medal to M. A. S. Woeikoff for his important work, "The Climates of the Globe, and especially of Russia." Analysing this work in the "Annual Report for 1884" of the Society, Dr. Robert E. Lenz shows how original it is in its fundamental idea. Instead of representing the climates as they result from the averages of climatological elements, as is usually done in meteorological works, M. Woeikoff, like Dr. Hann in his "Handbuch der Klimatologie," but with much more fullness and details, tries to explain the local alterations which the general meteorological laws are submitted to in various countries in consequence of the topographical features of these last; and he verifies his conclusions with regard to each country by comparing them with those arrived at as to the climates of neighbouring countries, and establishes thus the elements of a comparative meteorology. The exter[...] travels of the author in Asia and America have enabled [...] recognise the leading meteorological features of the clim[...] describes and to become acquainted, by personal kno[...] with the topographical features of each separate region. [...] first twenty-two chapters of this volume, 640 pages, are de[...] to a detailed analysis of the chief meteorological elements: heat received from the sun; the dynamical and thermical con[...]

quences of the rising and falling of masses of air; the hydrometeors and their influence on the climates of separate regions—many quite new and original remarks and observations being embodied in these five chapters; the influence of snow and ice-coverings—two chapters again where the meteorologist and geologist will find a series of most interesting suggestions; the temperature of lakes, seas, and oceans; the influence of wind; the variations of temperature with the height—very carefully discussed; the diurnal changes and the unperiodical ones; and finally, the influence of climate on vegetation, and *vice versâ*—again two chapters full of new appreciations. The climates of eight separate regions—Atlantic, North and Middle America, Tropical America, Middle and South Africa, Mediterranean basin, North-West and Middle Europe, South-Eastern Asia, and finally Russia and Northern Asia, are discussed with great detail and with a richness of quite new data in ten separate chapters. Needless to add that the author, well acquainted with so many foreign languages, has embodied in his work all that is worthy of notice in meteorological literature. The work is illustrated by ten maps and fourteen drawings, and contains very numerous tables.

DURING the opposition of Neptune, just passed, we learn from *Science*, Prof. Pickering continued the observation of the planet's magnitude with the meridian photometer of the Harvard College Observatory in the same method as previously employed. Nine series of observations extend from December 16, 1884, to January 21, 1885, the final result from which, when corrected for atmospheric absorption, instrumental error, and reduction to mean opposition, becomes 7·63. The residual difference for only one series is as great as two-tenths of a magnitude. The corresponding results for two previous seasons are 7·71 and 7·77. Contrary to the experience of Mr. Maxwell Hall, of Jamaica, who found evidence for a rotation-period of Neptune in small variations of the planet's light according to his own observations, Prof. Pickering regards it as improbable that there is any variation in the light of Neptune of a strictly periodic character, and further calls attention to the influence, much neglected by observers, upon the observed brightness of objects when seen east and west of the meridian on the same night. This has to be taken account of in the observations of maxima and minima of many variable stars, and may to some extent account for the variations of Neptune's light detected by Mr. Hall.

THE report of the Post Office, Telegraph, and Observatory Departments of South Australia for the past year contains a detailed account *inter alia* of the work of the Observatory Department in that colony since its foundation in 1867. It would be impossible to do more than refer generally here to numerous details given in the ten closely-printed foolscap pages devoted to the subject. Since its establishment the department appears to have kept pace with the strides of the colony to which it belongs. The astronomical observatory at Adelaide is now well supplied with meteorological appliances, having self-recording and other instruments necessary to constitute it a first-class station as defined by the Meteorological Congress at Vienna. There are also fourteen well-equipped stations of the second order, scattered all over the colony, from Port Darwin, in the extreme north of the continent, to Cape Northumberland in the extreme south. Rain-gauges are kept at every telegraph office in the colony; in 1870 there were reports from forty-six stations; in 1883 from 254, and there are still large gaps to be filled up. A system of weather-telegraphy has been arranged between the Australasian colonies, these being divided into districts or aspects to facilitate the transmission of the messages, and to afford the necessary data for laying down the isobars. The important operations undertaken to determine Australian longitudes are also described in detail. Mr. Todd, the head of the combined departments—post, telegraph, and observatory—anticipates great assistance in the inter-colonial meteorological part of his work from Mr. Clement E. Wragge's high-level meteorological station on Mount Lofty, "as he brings to his work great practical experience and almost unbounded enthusiasm."

THE last number (vol. v. No. 4, 1885) of the *Proceedings* of the Bath Natural History and Antiquarian Field Club contains papers on the group of stones at Stanton Drew, in Somersetshire, by Mr. J. Allen Tucker, in which he favours the theory that these huge monuments are the remnants of a temple, either erected by the Druids or by some primeval or prehistoric race, and only used by the Druids, and were not intended to commemorate a battle, which was too common an event in early times; by Rev. L. Blomefield, on a second specimen of the rare Longicorn beetle found in Bath; by Mr. Williams, on the natural history of British owls; and by Mr. Morgan, on water-supply, principally as applied to domestic purposes. There are also several minor contributions noticed in the summary of proceedings at the meetings.

WE have received the prospectus of a Field Club for Hampshire, the Honorary Secretary to which is Mr. E. Westlake, Fordingbridge, Salisbury. The first meeting is to be held at Winchester on May 28. The marvel is that a county as varied as any in England in this respect should have been so long without its Naturalists' Field Club. White of Selborne on the east, and Kingsley on the north, have made the county a classic one for students of nature. With these examples to live up to, and such a field as Hampshire (including the Isle of Wight) the Proceedings of the new club should be interesting and successful.

THE Report of the Committee of the Kelvingrove Museum of Glasgow for the past year illustrates the truth of a remark of Mr. Higgins in his pamphlet on museums recently noticed in these columns, viz. that the number of museums in which a sum of money could be best spent in making additions is very small; that is, as a rule, arrangement is more needed than acquisition. The Committee of the Kelvingrove Museum report that the establishment has been overcrowded for years, that the enormous amount of specimens of all kinds stored away out of sight is constantly increasing, and that the labour and unremitting watchfulness required to keep such stored specimens from deteriorating grows in proportion, and withdraws from essential and more useful museum work much of the time of the small staff, and it has thus become from year to year increasingly difficult to undertake any considerable project for improving the order, classification, or labelling of any section of the museum. This is certainly a grave evil, for it threatens to destroy the main object of such a museum, viz. public instruction. It is to be hoped that a wealthy and public-spirited town such as Glasgow will not permit this state of things to continue; for, as the Report points out, from the stores already within the museum, supplemented in some departments by inexpensive and easily acquired objects, a natural history museum could be equipped which would satisfactorily illustrate all the range of the animal kingdom, and prove at once of great value to the student of zoology, and a popular attraction to the public. For the rest, there has been "a large, steady, and well-maintained flow of visitors, which does not show any indication of waning."

THE Lyceum of Natural History of Williams College, Williamstown, Mass., the oldest natural history society but one connected with any college in the United States, will celebrate its fiftieth anniversary on the 24th of this month, at which a former member, Dr. W. K. Brooks, of the class of 1870, now Associate of Johns Hopkins University, will deliver an address. The Lyceum proposed to take advantage of the occasion to raise funds to enable it to undertake expeditions to some spot, similar to those which it has undertaken in former years to Labrador, Florida, &c.

We learn from *Science* that the Leander McCormick Observatory of the University of Virginia was inaugurated on April 13, the ceremonies taking place in the public hall of the institution, and Prof. Asaph Hall, of the Naval Observatory, Washington, delivering the address. The principal instrument is the great Clark refractor of 26 inches' aperture. The Observatory has a house adjoining for the director, Prof. Stone, and is possessed of a considerable endowment fund, the gift of Mr. W. H. Vanderhilt, of New York.

Capt. L. U. Herendeen, of San Francisco, communicates the following notes on prehistoric structures in Micronesia to *Science*:—A few years ago I visited Ponapé Island in the Pacific, in E. longitude 158° 22', and N. latitude 6° 50'. The island is surrounded by a reef, with a broad ship-channel between it and the island. At places in the reef there were natural breaks, that served as entrances to the harbours. In these ship-channels there were a number of islands, many of which were surrounded by a wall of stone five or six feet high; and on these islands there stood a great many low houses, built of the same kind of stone as the walls about them. These structures seem to have been used as temples and forts. The singular feature of these islands is that the walls are a foot or more below the water. When they were built, they were evidently above the water, and connected with the mainland; but they have gradually sunk until the sea has risen a foot or more around them. The natives on the islands do not know when these works were built: it is so far back in the past, that they have even no tradition of the structures. Yet the works show signs of great skill, and certainly prove that whoever built them knew thoroughly how to transport and lift heavy blocks of stone. Up in the mountains of the island there is a quarry of the same kind of stone that was used in building the wall about the islands; and in that quarry to-day there are great blocks of stone that have been hewn out, ready for transportation. The natives have no tradition touching the quarry—who hewed the stone, when it was done, or why the work ceased. They are in greater ignorance of the great phenomena that are going on about them than the white man who touches on their island for a few hours for water. There is no doubt in my mind that the island was once inhabited by an intelligent race of people, who built the temples and forts of heavy masonry on the high bluffs of the shore of the island, and that, as the land gradually subsided, these bluffs became islands.

A correspondent recently referred to the use of artificial teeth by the ancient Romans, as shown by a passage from Cicero, where one of the laws of the Twelve Tables is quoted. The law in question belongs to the Tenth Table (*de jure sacro*), which deals mainly with funerals, with the object of limiting the display and ceremonies attending them. Thus the body must not be burnt in more than three robes, or be attended to the grave by more than ten musicians; women must not tear their faces in time of mourning, nor must the bones be collected to make a new funeral with them, the bodies of slaves could not be embalmed, and the like. Section IX. of Table X., which is the one relating to teeth, reads as follows in Ortolan's text ("Histoire de la Législation Romaine," p. 121): "*Neve aurum addito. Quoi auro dentes vincti escunt, ast im cum illo sepelire urereve se fraude esto*—Add no gold; but if the teeth are bound with gold, then that gold may be buried or burnt with the corpse." The date of the Twelve Tables is put about 450 B.C., and it is thought possible by some writers that some of the provisions relating to funerals were taken from the laws of Solon. It would therefore appear that dentistry was known and practised to some extent in the earliest period of their history by the Romans—to an extent, at any rate, that they used gold for binding the teeth. How the artificial teeth were made, or whether they had artificial teeth at all, is not apparent. In the case of the Etruscan skull mentioned recently in Nature, the artificial teeth are made from the teeth of animals.

M. Soroloff, who continues his regular analyses of the water of the Neva, has come to the conclusion that the differences between the average monthly content of solid mixture in the water and the yearly average may be expressed by a curve whose characteristics are the opposite to those of the curve for the average monthly temperatures. The solid inorganic deposit remaining after the evaporation of a given amount of water is also inversely proportionate to the amount of organic matter contained by the water of the Neva. When comparing these curves for the Neva with that showing the amount of solid matter contained by the Thames (as given in the *Journal* of the London Chemical Society for 1880), it appears that both rivers give the same curves, notwithstanding the wide difference of their origins, which coincidence may lead to the supposition that the above might be considered as a law for the rivers.

The additions to the Zoological Society's Gardens during the past week include a Yellow Baboon (*Cynocephalus babouin* ♀) from West Africa, presented by Mrs. Wilson; a Lesser White-nosed Monkey (*Cercopithecus petaurista* ♀) from West Africa, presented by Mr. James S. Jameson; a Crested Pigeon (*Ocyphaps lophotes*) from Australia, presented by Mr. J. Harrison; a Glaucous Gull (*Larus glaucus*), European, presented by Mr. G. Edison; a Common Viper (*Vipera berus*), British, presented by Mr. W. H. B. Pain; four Common Lizards (*Lacerta vivipara*), British, presented by Mr. H. Hanauer; a Common Squirrel (*Sciurus vulgaris*), British, three Wigeons (*Mareca penelope* ♀ ♀ ♀), three Pintails (*Dafila acuta* ♀ ♀ ♀), two Shovellers (*Spatula clypeata* ♀ ♀), five Common Teal (*Querquedula crecca* ♂ ♂ ♂ ♀ ♀), European, purchased; a Yak (*Poephagus grunniens*), born in the Gardens.

## *OUR ASTRONOMICAL COLUMN*

Tuttle's Comet.—This comet returns to perihelion in the present year under circumstances which are not favourable for its re-observation, without an ephemeris deserving of some degree of reliance. For the last return in 1871 the perturbations during the previous revolution were very accurately determined by Tischler, of Königsberg, who lost his life before Metz in the Franco-German war; and the comet was detected at Marseilles about seven weeks before the perihelion passage, and was followed at the Cape of Good Hope for a still longer period after it. So far it does not appear that the observations of 1871-72 have been brought to bear upon the predicted elements, nor has it been notified that any one is occupied in ascertaining the effect of planetary attraction since the comet was last observed. Tischler's mean motion for 1871, neglecting perturbation, would bring the comet to perihelion again about 1885, September 23·5 G.M.T., and under this condition the comet's position will by readily commanded during the absence of moonlight in August, but unfortunately the theoretical intensity of light will be below the least value with which it has been thus far observed. Assuming the perihelion passage to fall on September 23, the following would be the rough places of the comet:—

*At Greenwich Midnight*

| | R.A. ° | Decl. ° | Distance from Earth | Distance from Sun | Intensity of Light |
|---|---|---|---|---|---|
| August 10 | 106·5 | +33·8 | 1·89 | 1·22 | 0·19 |
| 14 | 110·1 | 31·6 | 1·85 | 1·19 | |
| 18 | 113·6 | 29·3 | 1·82 | 1·17 | 0·22 |
| 22 | 117·0 | 26·7 | 1·78 | 1·14 | |
| 26 | 120·4 | +24·0 | 1·75 | 1·12 | 0·26 |

In 1871, when the comet was detected by Borrelly at Marseilles with the aid of Tischler's ephemeris, the intensity of light was 0·54, and at the last Cape observation, 0·33. On August 10 the effect of an acceleration of eight days in the time of perihelion passage would be to increase the comet's right ascension rather more than 3°, and to diminish the declination about 4°·4.

in the middle of September it will have attained the value at which observations have been already made.

The comet was first observed by Méchain on January 9, 1790. It was rediscovered by Mr. Tuttle at Cambridge, U.S., on September 5, 1858; from the observations made in this year its period was ascertained to be about 13·8 years, so that the comet had completed five revolutions since it was found by Méchain, without having been perceived. According to Clausen's calculations it was in perihelion on the following dates:—1803, November 7; 1817, May 18; 1830, December 6; and 1844, June 28. It approaches nearest to the orbit of Jupiter in heliocentric longitude 264°, or at a true anomaly of about 144°, when its distance from the planet's orbit is 0·8. At the comet's last passage through this point in July, 1873, the distance from Jupiter was as great as 8·9.

Subjoined are the elements of the orbit for 1871, expressed as usual in the catalogues, and with a slight correction to the predicted time of perihelion passage, which the observations showed to be required:—

Perihelion passage, 1871, December 1·7974 G.M.T.

| | | |
|---|---|---|
| Longitude of perihelion | 116 4 30 | Mean Equinox, 1870 |
| " ascending node | 269 17 12 | |
| Inclination | 54 17 0 | |
| Eccentricity | 0·8210540 | |
| Log. perihelion distance | 0·0128823 | |
| " semi-axis major | 0·7601603 | |

The corresponding period of revolution is 5044·7 days, or 13·812 years.

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, MAY 10–16

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on May 10*

Sun rises, 4h. 18m.; souths, 11h. 56m. 12·1s.; sets, 19h. 35m.; decl. on meridian, 17° 44′ N.; Sidereal Time at Sunset, 10h. 50m.

Moon (New on May 14) rises, 2h. 28m.; souths, 8h. 24m.; sets, 14h. 31m.; decl. on meridian, 1° 30′ S.

| Planet | Rises h. m. | Souths h. m. | Sets h. m. | Decl. on meridian ° ′ |
|---|---|---|---|---|
| Mercury | 3 55 | 10 31 | 17 47 | 10 7 N. |
| Venus | 4 25 | 12 3 | 19 41 | 17 35 N. |
| Mars | 3 42 | 10 44 | 17 46 | 11 23 N. |
| Jupiter | 11 25 | 18 41 | 1 57* | 13 49 N. |
| Saturn | 6 7 | 14 15 | 22 23 | 22 15 N. |

* Indicates that the setting is that of the following day.

*Occultations of Stars by the Moon*

| May | Star | Mag. | Disap. h. m. | Reap. h. m. | Corresponding angles from vertex to right for inverted image ° ° |
|---|---|---|---|---|---|
| 11 | 44 Piscium | 6 | 3 27 | near approach | 160 — |
| 16 | 130 Tauri | 6 | 15 31 | 19 27 | 13? 298 |

*Phenomena of Jupiter's Satellites*

| May | h. m. | | May | h. m. | |
|---|---|---|---|---|---|
| 10 | 20 46 | II. occ. disap. | 14 | 19 46 | I. tr. ing. |
| 13 | 1 17 | I. tr. ing. | | 22 6 | I. tr. egr. |
| | 21 58 | IV. occ. disap. | 15 | 20 27 | I. ecl. reap. |
| | 22 25 | I. occ. disap. | | | |
| | 22 35 | III. ecl. reap. | | | |

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

| May | h. | |
|---|---|---|
| 10 | 10 | Mercury stationary. |
| 11 | 9 | Mercury at greatest distance from the Sun. |
| 13 | 4 | Mercury in conjunction with and 0° 21′ south of the Moon. |
| 13 | 4 | Mars in conjunction with and 2° 4′ north of the Moon. |
| 13 | 9 | Mercury in conjunction with and 2° 27′ south of Mars. |
| 14 | 18 | Venus in conjunction with and 3° 47′ north of the Moon. |
| 16 | 15 | Saturn in conjunction with and 4° 2′ north of the Moon. |

## GEOGRAPHICAL NOTES

We regret to learn that the well known African explorer, Dr. Gustav Nachtigal, died on April 24, on board the German gun boat *Möwe*, off the west coast of Africa. Dr. Nachtigal was born at Eichstadt in 1834, and was trained to the medical profession. In 1862 he went to Algiers on account of his health, and in 1868 he started on his memorable journey into the heart of Africa, visiting the territories of Bornu, Baghirmi, Wadai, Darfur, Kordofan, emerging at Khartoum in 1874. This work placed Dr. Nachtigal in the front rank of African explorers. At the time of his death, it is well known, he was looking after the interests of Germany in connection with its recent annexation in West Africa.

The death is announced from Königsberg of Dr. Karl Zeppritz, Professor of Geography in the University there, and well known as the author of the reports on the progress of geophysics and of African exploration in Behm-Wagner's Geographical Year-Book.

On Monday last a lecture was delivered at the Alexandra Palace by Prof. A. H. Keane, on "The Lapps: their Origin, Type, Affinities, Social Usages," in connection with the company of Lapps who have recently arrived in London and pitched their tents on the slopes of Muswell Hill for the summer months. The group consists of seven persons, mostly members of one family, from the Karasjok district in Finmark, Norway, and belongs to the "mountain" or nomad division of the race. As these "Mountain Finns," as the Norwegians call them, are of much purer descent than the "River" and "Sea" Lapps, who have given up their nomad life and now reside in settled communities either along the riverain tracts or on the sea coast, they afford ethnologists a favourable opportunity of studying the type of these primitive inhabitants of the Arctic regions of North-West Europe. They are accompanied by six reindeer and two native dogs used for tending the herds, and have also brought with them specimens of the three kinds of sledges still in use, and some of the famous snow-shoes with which they travel with such surprising velocity over the frozen surface of the ground. The average height appears to be about five feet (extremes, 4·10 to 5·4 in.), but in some other respects the type seems to have deviated considerably from the Mongolic, to which it fundamentally belongs, and has been assimilated, especially in the colour of the hair and eyes, in the complexion and shape of the nose, to the surrounding Norse populations. But the lecturer seemed disposed to attribute this assimilation rather to like climatic influences than to actual intermixture, of which there is no direct evidence.

At the last meeting of the Geographical Society of Paris, M. Thouar described in detail the observations made by him during his recent journey in search of the remains of the unfortunate Crevaux expedition in the Northern Chaco. These were divided into notes on the flora and fauna, with specimens of the dialects of the Tobas, Matacos, and Chiriguanos, a description of the dress, ornaments, implements, utensils, &c., of the Tobas and Chiriguanos, anthropological details of the same tribes, an itinerary from Tarija to Asuncion, with numerous meteorological observations, and two documents belonging to the Crevaux mission. He added a study on the Peruvian and Bolivian affluents of the Amazon. With reference to the statement (recently quoted in NATURE) that certain members of the mission were still alive amongst the Indians, M. Thouar stated that this information should be received with the greatest reserve, because the date to which it referred was prior to his own sojourn on the frontier, which he traversed from north to south when no one gave him any such information. Since his return to France he has received directly from Bolivia numerous communications from Dr. Giannecchini, who lives on the frontier; in these nothing is said on the subject. A monument to Dr. Crevaux is to be unveiled at Nancy on June 13.

The Geographical Society of Paris has awarded a gold medal (La Rompuette's prize) to the well known Danish Government publication on Greenland, "Meddelelser om Grønland," in which are from time to time published the results of the Danish scientific expeditions exploring that continent. The same honour has befallen Danish subjects twice before, viz. Lieut. Graah, for his explorations of the east coast of Greenland; and Messrs. Bredsdorff and Olsen, for their map, "Esquisse d'une Carte [illegible]graphique de l'Europe."

GEOGRAPHICAL education in Sweden has for years left much to be desired, but of late steps have been taken for its improvement. In the so-called "Elementar-larovarken" (classical schools) geography has hitherto been classed as an appendix to history, and at the "Lektor" (candidate) examinations in history and geography questions are only asked about the former study. And while the hours and parts of history-teaching in the schools are detailed, no such arrangement has been made as regards geography; the hours of teaching are, in some cases, even not fixed. However, at the congress of teachers held in Stockholm last year, a resolution was adopted to the effect that geography ought to form a separate study of the school education. The University of Lund is the only institution which possesses an eminent geographer for this Board of Science, viz. Baron von Schverin, who, last year, represented Sweden at the Geographical Congress in Toulouse.

THE last Annual Report of the Russian Geographical Society contains extracts from letters addressed by M. Prjevalsky to the Grand Duke Alexander Alexandrovitch, which contains some further interesting details about his Hoang-ho journey. About the end of May he reached, as known, the foot of the Burkhan-budda Mountains, which inclose the high Thibet plateau separating it from Tsaidam. Leaving there his baggage, he went with only thirteen men to the sources of the Yellow River. The climbing on the 15,700 feet high passage of the Burkhan-budda ridge took three days. The descent, on the contrary, was very short, the plateau of Thibet being there 14,000 to 15,000 feet high. Further 60 miles across the desert plateau brought the traveller to the sources of the Yellow River. They are 13,600 feet above the sea-level, and consist of two rivers coming from the south and west and rising in the hills scattered on the plateau. A wide marshy valley, Odon-tala, 40 miles long and 20 miles wide, feeds numerous springs. The Hoang-ho itself is only a rivulet dividing into two or three branches, each of them but 80 to 100 feet wide, and only 2 feet deep at low water. Some 13 miles below this place the Hoang-ho enters a broad lake, colouring its southern part with its muddy water, and, after leaving it on the east, it enters again another lake, whence it flows out as a large river; further down it makes a great curve to avoid the snow-covered Amis-matchin range, and breaks through, in a wild course, the parallel ridges of the Xuen-lun. On the Thibet plateau the expedition experienced dreadful cold. In the second half of May snow-storms were as strong as in winter, and the night frosts reached $-23°$ Celsius. Still the thin grass covering did not perish and a few flowers reappeared every day under the sun-rays. Even in June and July the thermometer fell during bright nights as low down as $-5°$. As to rain, it poured every day, sometimes several days without interruption. The amount of vapour brought by the south-west monsoon and deposited there is so great that, during the summer, Northern Thibet becomes an immense marsh. Needless to say that the advance was difficult for camels. Though uninhabited by man, these deserts were full of herds of yakes, khoulans, antelopes, and mountain sheep; even bears were seen in groups, sometimes of more than ten at once; some thirty pairs were shot down; they are altogether very cowardly, and fly even when wounded. After having spent a few days at the source of the Hoang-ho, M. Prjevalsky went south to the Blue River, called there Dy-tchou by the Tangoutes. The plateau remained hilly, mostly covered with marshes, where the Thibet rush, hard as iron wire, grows freely. The water-divide between the two rivers has an altitude of 14,500 feet. Further south the region takes the characters of an Alpine country, still devoid of forests, but with a richer and more varied grass vegetation. Tangoutes, of the Kam branch, were met with, and received the travellers, though not friendlily, yet not as enemies. Some 70 miles across a mountain region brought M. Prjevalsky to the Dy-tchou River, at an altitude of 12,700 feet. The river, deep and very rapid, is 350 to 420 feet wide. To ford it with camels was quite impossible, so that a further advance to the south had to be renounced. So it was decided to stay there a week and then return to explore the great lakes of the Hoang-ho. ...ing this stay the Tangoutes fired once from the opposite bank ...y-tchou. Returning to the Hoang-ho, M. Prjevalsky ...er route to reach the lakes of this river, finding his ... guides. The Tangoutes closely followed the party, ... suddenly attacked them. This attack, as also ... repulsed, and the only further difficulties were ...w-storms (end of July). On the southern ...dda Mountains a party of gold-washers was met with. They did not dig the soil deeper than one or two feet, and their washing was most primitive. Still they showed handfuls of gold, mostly in corns as large as a pea, or twice and thrice the size. After having thus laid over more than 670 miles the party returned to Tsaidam, which appeared to them, as desert as it is, a real Eldorado in comparison with the Thibet plateau.

BESIDES the special medals awarded to M. Woeikoff and M. N. J. Zinger, the other medals of the Russian Geographical Society have been awarded as follows:—Small gold medals to the members of the last Pamir expedition, Col. Putyata; M. Ivanoff, geologist; and M. Bendersky, topographer, as also to M. Gavriloff for a manuscript on the religious beliefs of the Votyaks, and to Prof. Zomakion for magnetic measurements at Kazan. The great gold medals were awarded this year by the Sections of Ethnography and Statistics to M. Shein for his "Materials for the Study of the Customs and Language of the Russian Population in the North-West Provinces of Russia," and to M. Yanjul on the manufactures of the Government of Moscow. Sixteen silver medals have been awarded for several papers published in the publications of the Society, for observations extended over more than ten years on thunderstorms and rainfall, to those students who helped Prof. Zomakion in his magnetic measurements, and so on.

THE eccentricities of the European nomenclature of distant regions is well exemplified in the case of the eastern portion of the Indo-Chinese peninsula to which so much attention is attracted just now by the political events in progress there. On some English maps we find four separate divisions: starting from the north, Tonquin placed next to China; then Annam; then Cochin-China, and finally French Cochin-China. In the map accompanying Mr. Colquhoun's recent work, "Amongst the Shans," territory inhabited by independent tribes is inserted between Tonquin and China, which gives five divisions. This latter, however, is wholly incorrect, as the Tonquin frontier proper marches with that of China. In other maps (chiefly in those published in France) Annam and Cochin-China are thrown in together and called indifferently Annam or Cochin-China; while in others, mainly those of from ten to twenty years old, the whole coast from the Chinese frontier to the French colony of Saigon is called sometimes Cochin-China, sometimes Annam. We derive the name Cochin-China from the early navigators, who applied it to the whole coast round from Siam to China; and various generations, in search of trade rather than of geographical accuracy, have added to the confusion. Since the beginning of the present century, when the rulers of Annam imposed their yoke on Tonquin, there has been only one political power on this coast, viz. Annam. As the territories of this State stood twenty-five years ago, it was bounded by China, the Shan States, Siam, Cambodia, and the ocean, and, with the exception that France obtained three small States at the extreme south in 1861, so it stands at present. Tonquin was a feudatory State of Annam when the present war broke out. In a history of Annam recently published by Abbé Launay, a missionary in these regions, we find his title-page runs thus: "Histoire Ancienne et Moderne de l'Annam—Tong-King et Cochin-Chine—depuis, &c., &c.;" and in some interesting preliminary observations on these names, he explains that the titles Tonquin and Cochin-China are relatively recent, and are employed only by Europeans, and never by the Annamites. Tonquin comes to us from *Dong-kinh*, formerly the name of the capital, now called Hanoi; while Cochin-China comes from *Chen-chin*, the name given to the ancient State of Ciampa, situated to the extreme south of the peninsula. *Chen-chin* was probably preceded at one time by *Cao*, an abbreviation of Cao-tchi (*Giao-chi*), and from *Cao-chen-chin* Europeans have made Cochin-China. The name Annam was first given by the Chinese in the third century of our era. It was never used in the official documents between the two countries, but it is that by which the Annamites now call their country. It was at first applied to Tonquin only, but it was extended by conquest to Cochin-China, the ancient Ciampa. It should not, says Abbé Launay, be used for Cochin-China as distinct from Tonquin, but to the two united. The term *Giao-chi*, above alluded to, was that employed in the earliest epochs for the people inhabiting Annam, and was extended to the country. Their historians record that when the Emperor of China, Hoang-ti, formed the Chinese Empire in the twenty-sixth century before our era, he took Giao-chi as his boundary in the south-west. An ancient sacred book of the Chinese, the "Chou-king," which was collected in the sixth century before our era by Confucius from the remnants of still earlier works, refers to a tribe south of the Chinese frontier as the Giao-chi, which means "toes spread out," or "far apart," a term which points to a wide separation between the great toe and the others. This curious distinctive racial mark exists to-day, notwithstanding the lapse of time and the social revolutions of twenty-five or thirty centuries amongst the Annamites. We might therefore adopt the native distinctions as stated by Abbé Launay *en bloc*, and call the whole region Annam, with sub-divisions Tonquin and Cochin-China; or, making a sacrifice of strict accuracy to long habit, we might call the whole Cochin-China, with sub-divisions Tonquin and Annam. But it is probably as hopeless at present to expect strict uniformity in these names as it is to expect it in the orthography of Tonquin, although uniformity even in doing wrong would be better here than the present confusion.

AT the meeting of the Dutch Geographical Society on April 18, Mr. Robidée Van der Aa delivered a lecture on "Papuans and Melanesians, and their Relation to the Malay-Polynesian Race." Succinctly stated, the opinions expressed in the lecture were these:—The opinion once prevailed that the Papuans were the autocthones of the Malayan Archipelago, but that they were conquered by the Malays. There is, however, no support for this supposition, since in the interior of none of the Sunda Islands has a tribe been found bearing any resemblance to the Papuans. Since the researches and discoveries of Miklucho-Maclay we may not consider their hair or their dark skin as a decisive distinction with regard to other tribes. Moreover, it is now stated that their language is related to the Malayan tongue; there are still many customs and usages found amongst them similar to those met with among Malays. From all this Mr. Van der Aa concludes that the Papuans are one of five families, all of which have descended from one "insular race," and were separated from each other at an early date.

THOUGH nothing was said at the Dutch Geographical Society on April 18 about the expedition undertaken to the West Indies by Prof. Martin and Prof. Suringar, we now learn that they left Curaçoa in March. The former, accompanied by Mr. Van de Poel, arrived at Paramaribo and intended to make an excursion to the "Boven Suriname" on March 30; the latter intends to go to Venezuela, and after that to some of the Windward Islands, viz. St. Martin's, St. Eustathius, and Saba.

WE take from the Annual Report of the Russian Geographical Society the following figures giving the average temperatures for twenty-two months at the Sagastyr Polar Station at the mouth of the Lena. The following figures are on the Centigrade scale, and the first of them gives the average of the corresponding month for the year 1882–1883, while the second is the average of the same month for the year 1883–1884:—September, 0°·1 and 0°·6; October, −15°·1 and 14°·1; November, −27°·9 and −25°·7; December, −33°·5 and −33°·3; January, −37°·2 and −35°·8; February, −41°·3 and −34°·0; March, −31°·5 and −35°·2; April, 20°·7 and −21°·8; May, −8°·1 and −9°·7; June, 0°·9 and −0°·2; July, 5°·1; August, 3°·8. Average of the first year, −17°·1; of the second (incomplete), −16°·7. As seen, both years are closely similar; the exceedingly low temperatures of February, 1883, are most remarkable, the average of the month being only −41°·3, and the lowest temperature observed having been −52°·3 for the first year and −48°·0 during the second. The auroras were also less frequent, and the magnetic perturbances feebler. The number of hours during which auroras were observed is seen from the following figures:—September, 13 hours in 1882–1883, and 23 hours in 1883–1884; October, 87 and 69; November, 179 and 83; December, 191 and 178; January, 194 and 151; February, 197 and 126; March, 137 and 118; April, 10 and 8; none in May to August. Total for the first year, 1008; for the second, 756.

IT results from the same report that the delta of the Lena extends, by nearly one-half a degree, further north than on our best maps. The northern cape of the Danube (Dounay) Island is under 73° 55′ north latitude. This determination does not correspond with the Vega map, where Sagastyr, being under 73° 21′, the northern extremity of the island is under 73° 27′, and the course of the Vega in this longitude is under 74° 8′. At any rate, M. Yurgens has been compelled to go for twenty miles north of Sagastyr before reaching the extremity of the Dounay Island.

## *SOME EXPERIMENTS ON THE VISCOSITY OF ICE*

THAT ice will change its form under the influence of pressure is exemplified at large in glaciers, and may be illustrated by experiments in the laboratory. How far this is due to a true viscosity, and how far to a rearrangement of the particles by melting and regelation, is a question the discussion of which among physicists has been of long continuance, though there there may now perhaps be some signs of permanent yielding under the influence of continuous pressure.

In the first volume of NATURE (p. 534) Mr. Wm. Matthews describes experiments (1870) in which planks of ice, supported at each end, but free in the middle, become permanently bent. In the first of these experiments the plank was 6 inches wide, 2¾ inches thick, and supported by bearers 6 feet apart. The temperature of the air was above the freezing-point of water. The plank bent rapidly, so that the total deflection was 7 inches in about as many hours. "At its lowest point it appeared bent at a sharp angle, and was rigid in its altered form." Its lower surface showed minute fissures. In a second experiment a plank of somewhat similar dimensions (1¾ inch thick, 6½ to 6¼ inches wide, 6 feet between the supports) became permanently bent. The amount of deflection was 3½ for the upper surface and 3½ for the lower surface. The time was 64½ hours. The temperature "never rose above the freezing-point"; but the fact that the thermometer registered 29°·5 F. one morning at 9.30 a.m., and 30° F. the next morning at the same time, would lead us to suppose that the midday temperature was not far from the freezing point. Similar experiments were subsequently carried out (1871) by Prof. Tyndall, in Switzerland, and are mentioned in NATURE (vol. iv. p. 447).

In NATURE, vol. vi. p. 396, Mr. John Aitken describes experiments in which weighted shillings were caused to sink into blocks of ice. But when the block of ice was previously cooled to about 1° below the freezing-point, a shilling weighted with 90 lbs. and left for three and a half hours, "was found not to have entered in the slightest degree into the ice." Subsequently, in 1873 (NATURE, vol. vii. p. 287), Mr. Aitken described experiments which showed that ice bends the more readily the more air-bubbles it contains. "Temperature," he says, "seemed to have some influence on the rate of bending of these beams, but this point was difficult to determine on account of the different beams bending at different rates at the same temperature; but, so far as could be ascertained from the experiments, the beams bent slower the lower the temperature. The lowest temperature used in these experiments was [illegible] more than 3° F. below freezing."

In 1875 Prof. Pfaff described in *Poggendorff's Annalen* [illegible] p. 169, reported in NATURE, vol. xii. p. 317) a carefully conducted experiment in which a paralellopiped of ice 52 cm. long, 2·5 cm. wide, and 1·3 cm. thick, was supported in such a way that 5 mm. at each end rested on the bearers. This was left for seven days, from February 8 to February 15, the temperature varying between −12° and −3·5° C. The total bend was 11·5 mm. That is to say, to translate these measurements into inches for the sake of comparison with the other results, in a bar 20 inches in length between the supports, 1 inch in width, and ½ inch in thickness; the total bending was a little over ·45 of an inch. When the temperature rose to slightly under 0° C. the bending increased, and amounted to 9 mm. (·34 inches) in 24 hours. Other experiments are described by Prof. Pfaff in the same paper, and the general conclusion to which he is led is "that even the smallest pressure is sufficient to dislocate ice-particles if it act continuously, and if the temperature of the ice and its surroundings be near the melting point."

In the current volume of NATURE (p. 329) there is a report of a paper recently read before the Royal Society by Mr. Coutts Trotter (to whom I am indebted for references on this subject) "On some physical properties of ice, &c.," in which were described some experiments on the shearing of ice, carried out in a glacier grotto at a nearly [illegible] temperature of about 0° C. In that report we l[illegible] "reasons" are given for supposing [illegible] which ice is sensibly [illegible]

So far as I know [illegible] very low temperat[illegible] the present com[illegible] which I have [illegible] courtesy of M[illegible] chamber of [illegible]

In this chamber the air, which has been previously condensed and cooled, is allowed to deposit, in the form of snow, the moisture which it can no longer retain owing to the great diminution of temperature due to expansion. George Punter, whose business it is to look after this snow chamber, rendered the most intelligent assistance in preparing the bars of ice, and in conducting the experiments. In this mode of experimentation the great variation of temperature, namely, between − 30° C., when the engines are stopped in the evening, and − 12° C., as a maximum when they begin work in the morning is an unavoidable drawback. Still, I think that the experiments, although they give uniformly negative results, are worth putting on record.

*Experiment* 1.—A cylinder of ice was cast with a diameter of 3 inches. Over it was hung, as in the well-known Bottomley experiment (NATURE, vol. v. p. 185), a wire loaded with a total weight of 5 lbs. It was left in the freezing-chamber 6½ hours. No dent was traceable on the surface of the cylinder.

*Experiment* 2.—With a similar cylinder and wire the load was increased to 10 lbs. and the time to 8 hours, with like negative results.

*Experiment* 3.—With a similar cylinder and wire the load was further increased to 14 lbs. and the time to 17½ hours, with the same result or absence of result. This experiment would seem to show that the ice refused to yield to a pressure of 20 to 30 atmospheres, or probably more, applied in this way and for this time.

*Experiment* 4.—A bar of ice 1½ inches thick, 2½ inches wide, and supported on bearers 13½ inches apart, was left in the chamber from 12 noon on Monday until 12 noon on Saturday. It showed no sign of bending under its own weight.

*Experiment* 5.—A similar bar similarly supported was weighted in the middle with 7 lbs., and left for the same time. No sign of bending.

*Experiment* 6.—A similar bar similarly supported was weighted with 18 lbs., and left for the same time. There was no bending perceptible to the eye; but, on removing the apparatus, the bar broke with the jar occasioned by setting it down somewhat carelessly, so that no exact measurement was taken.

*Experiment* 7.—A bar of the same length and width, but thinner, tapering somewhat from ⅞ to ⅝ of an inch in thickness, was weighted with 7 lbs., to which, during the last two days, seven additional pounds were added, and left for the same time. No bending by measurement.

Such negative results are just what one would expect on theoretical grounds, and as an inference from previous experiments conducted at temperatures nearer the melting-point. But it is well not to rely on theory or on inference where direct experiment is practicable

The matter, then, would appear to stand at present somewhat thus. The viscosity of ice, due to whatever cause, is—

(1) At temperatures at and above the melting-point ... considerable.
(2) ,, ,, below but near ,, ,, ... much less.
(3) ,, ,, between − 3°·5 C. and − 12° C. ... very slight.
(4) ,, ,, below − 12° C. ... ... ... *nil*.

What seems now to be wanted is an experimental determination of the lower temperature-limit of viscosity, which would appear to lie somewhere between − 12° C. and − 3°·5 C., but probably nearer the latter temperature.

University College, Bristol C. LLOYD MORGAN

## BEN NEVIS

AT the meeting of the Royal Society of Edinburgh held on Monday last, Mr. John Murray, Vice-President, in the chair, Mr. R. T. Omond, Superintendent of the Meteorological Observatory on Ben Nevis, delivered, at the request of the Council, an address on two years' residence and work there. Mr. Omond, at the outset, recalled the advantages which Ben Nevis presented as a high-level meteorological station, the services of Mr. Clement S. Wragge, and the chief steps that led up to the erection and equipment of the existing permanent observatory. Glancing at some of their daily experiences during last summer and autumn, he mentioned that some 3000 or 4000 tourists climbed the mountain—sometimes at least 100 in a single afternoon. Since the middle of October, however, not more than half a dozen strangers had ventured up. Some came for information; others were disappointed at finding they could not be fed as well as sheltered; others came to spend the night, but were disappointed at finding they could not do so. Most of the visitors, however, were satisfied, though a little astonished, by the explanation that the building on Ben Nevis was primarily a scientific observatory, and not a hotel. Storms of exceptional and terrific violence were described. Beautiful optical phenomena that had been witnessed, and the comparative scarcity of animal life on the mountain, were next alluded to. Rainbows are seldom seen. Thunderstorms are very rare. The temperatures during winter are not so low as many people think—10° F. is about the lowest recorded as yet, and the ordinary winter temperatures ran from 15° to 25°. Observing that much must yet be done in the work of the discussion and interpretation of the observations made on Ben Nevis, before the observations could be safely used, he proceeded to state some of the more interesting points which Mr. Buchan had already succeeded in approximately establishing: (1) The normal or average temperature and barometric pressure for each month, and the normal differences between these averages and those at sea-level. (2) The daily variation of temperature and pressure during each month. (3) The daily variation in the average velocity of the wind—this being shown to be greater at night than during the day, exactly the reverse of what holds good at sea-level. (4) Variations in the direction of the winds as compared with those prevalent over Scotland at any given time. A comparison of the Ben Nevis winds with those at low-level stations sometimes shows that both are part of one system, whether cyclonic or anti-cyclonic; but the direction is almost always different, and in the case of cyclonic storms, coming from the west. The observed differences in direction seem to give an indication as to whether the storm centre is to pass to the north or south of Ben Nevis. If this point can be definitely made out, it will obviously be of immense value in forecasting weather. (5) The hygrometric observations indicate that the atmosphere on the Ben shows that during ordinary weather a state of persistent saturation, usually accompanied by fog or mist, prevails; but occasionally a sudden and extraordinary drought sets in, the temperature rises, and the sky clears, not merely of fog, but often of every vestige of cloud, and at the same time the valleys and lower hills are often shrouded in mist, showing that this dryness coming from above is not able to penetrate right down to the sea-level. The thorough investigation of these phenomena is one of the most important pieces of work connected with the Observatory, and may be expected to throw great light on the question of atmospheric circulation. (7) The rainfall of Ben Nevis is greatly in excess of what several theories of the distribution of rain led them to expect—a result possibly due to the great vertical movements of the atmosphere indicated by the hygrometric indications referred to above. Though there are many high-level stations in different parts of the world, none, perhaps, are so favourably situated as Ben Nevis for the investigation of what he had explained is the present great problem in meteorology, namely, the vertical movements of the atmosphere. If the Scottish Meteorological Society were possessed of sufficient funds to establish a completely-equipped observatory at the foot of Ben Nevis as well as on the summit, he was convinced that the science of meteorology would advance far more in a few years than it would by a generation of ordinary work with low-level stations alone.

## SUNLIGHT AND THE EARTH'S ATMOSPHERE[1]

THERE is, we may remember, a passage in which Plato inquires what would be the thoughts of a man who, having lived from infancy under the roof of a cavern, where the light outside was inferred only by its shadows, was brought for the first time into the full splendors of the sun.

We may have enjoyed the metaphor without thinking that it has any physical application to ourselves who appear to have no roof over our heads, and to see the sun's face daily; while the fact is that if we do not see that we have a roof over our heads in our atmosphere, and do not think of it as one, it is because it seems so transparent and colourless.

Now, I wish to ask your attention to-night to considerati in some degree novel, which appear to me to show that it is transparent as it appears, and that this seeming colourlessne a sort of delusion of our senses, owing to which we have n

[1] Lecture delivered at the Royal Institution, April 17, 1885, by Langley. Communicated by the author.

in all our lives seen the true colour of the sun, which is in reality blue rather than white, as it looks, so that this air all about and above us is acting like a coloured glass roof over our heads, or a sort of optical sieve, holding back the excess of blue in the original sunlight, and letting only the white sift down to us.

I will first ask you, then, to consider that this seeming colourlessness of the air may be a delusion of our senses, due to habit, which has never given us anything else to compare it with.

If that cave had been lit by sunshine coming through a reddish glass in its roof, would the perpetual dweller in it ever have had an idea but that the sun was red? How is he to know that the glass is "coloured" if he has never in his life anything to compare it with? How can he have any idea but that this is the sum of all the sun's radiations (corresponding to our idea of white or colourless light)? will not the habit of his life confirm him in the idea that the sun is red; and will he not think that there is no colour in the glass so long as he cannot go outside to see? Has this any suggestion for us, who have none of us ever been outside our crystal roof to see?

We must all acknowledge in the abstract, that habit is equally strong in us whether we dwell in a cave or under the sky, that what we have thought from infancy will probably appear the sole possible explanation, and that, if we want to break its chain, we should put ourselves, at least in imagination, under conditions where it no longer binds us.

The *Challenger* has dredged from the bottom of the ocean fishes which live habitually at great depths, and whose enormous eyes tell of the correspondingly faint light which must have descended to them through the seemingly transparent water. It will not be so little a speculation as it may at first seem, to put ourselves in imagination in the condition of creatures under the sea, and ask what the sun may appear to be to them; for if the fish who had never risen above the ocean floor were an intelligent being, might he not plausibly reason that the dim greenish light of his heaven—which is all he has ever known—was the full splendour of the sun, shining through a medium which all his experience shows is transparent?

We ourselves are, in very fact, living at the floor of a great aerial sea, whose billows roll hundreds of miles above our heads. Is it not at any rate conceivable that we may have been led into a like fallacy from judging only by what we see at the bottom? May we not, that is, have been led into the fallacy of assuming that the intervening medium above us is colourless because the light which comes through it is so?

I freely admit that all men, educated or ignorant, appear to have the evidence of their senses that the air is colourless, and that pure sunlight is white, so that if I venture to ask you to listen to considerations which have lately been brought forward to show that it is the sun which is blue, and the air really acts like an orange veil or like a sieve which picks out the blue and leaves the white, I do so in the confidence that I may appeal to you on other grounds than those I could submit to the primitive man who has his senses alone to trust to; for the educated intelligence possesses those senses equally, and in addition the ability to interpret them by the light of reason, and before this audience it is to that interpretation that I address myself.

Permit me a material illustration. You see through this glass, which may typify the intervening medium of air or water, a circle of white light, which may represent the enfeebled disk of the sun when so viewed. Is this intervening glass coloured or not? It seems nearly colourless; but have we any right to conclude that it is so because it seems so? Are we not *taking it for granted* that the original light which we see through it is white, and that the glass is colourless, because the light seems unaltered, and is not an appeal to be made here from sense to reason, which, in the educated observer, recalls that white light is made of various colours, and that whether the original light is really white and the glass transparent, or the glass really coloured and so making the white, is to be decided only by experiment, by taking away the possibly deceptive medium? I can take away this glass, which was not colourless, but of a deep orange, and you see that the original light was not white, but intensely blue. If we could take the atmosphere away between us and the sun, how can we say that the same result might not follow? To make the meaning of this illustration clearer, observe that this blueness is not a pure spectral blue. It has in it red, yellow, blue, and all the colours which make up white, but blue in superabundance; so that, though the white is, so to say, latent there, the dominant effect is blue. The glass coloured veil does not put anything *in*, but acts like a sieve straining *out* the blue, and letting through white light which was there in the bluishness, and so our air do so too?

I think we already begin to see that it is at any rate able that we *may* have been hitherto under a delusion true colour of the sun, though of course this is not pr we have been so, and it will at any rate, I hope, be evi here is a question raised which ought to be settled, for ness of the sun, if proven, evidently affects our presen ledge in many ways, and will modify our present views in meteorology, and in numerous other things. In because we should find that white light is *not* the sum of radiations, but only of those dregs of them which have down to us; in meteorology because it is suggested that perature of the globe and the condition of man on it, de part on a curious selective action of our air, which picks of the solar heat (for instance, that connected with its lig and holds them back, letting other selected portions com and so altering the conditions on which this heat by w live, depends; in other ways, innumerable, because know, the sun's heat and light are facts of such central ance, that they affect almost every part of scientific know

It may be asked what suggested the idea that the sun blue rather than any other colour.

My own attention was first directed this way many y when measuring the heat and light from different parts sun's disk. It is known that the sun has an atmosphe own which tempers its heat, and, by cutting off certain ra and not others, produces the spectral lines we are all with. These lines we customarily study in connection absorbing vapours of sodium, iron, and so forth, which them; but my own attention was particularly given to the of absorption, or to the colour it caused, and I found sun's body must be deeply bluish, and that it would sh light except for the apparently colourless solar atmo which really plays the part of a reddish veil, le little of the blue appear on the centre of the sun's disk w thinnest, and staining the edge red, so that to delicate t centre of the sun is a pale aqua marine, and its edge The effect I found to be so important, that if this all but solar atmosphere were diminished by but a third part, perature of the British islands would rise above that of t zone, and this directed my attention to the great part portance of studying the action of our own terrestrial atm on the sun, and the antecedent probability that our own also and independently making the really blue sun into parently white one. We actually know then, beyond qu by a comparison of the sun's atmosphere, where it is and where it is thinnest, that an apparently colourless atm can have such an effect, and analogous observations have carried on for many years, but do not now deta that the atmosphere of our own planet, this seemingly to which we exist like creatures at the bottom of the se [illegible].

We look up through our own air as though were limpid in its purity that it appears scarcely matter at all, are apt to forget the enormous mass of what seems of ness, but which really presses with nearly a ton to each foot, so that the weight of all the buildings in this great c is a mere trifle less than that of the air above them.

I hope to shortly describe the method of proof that it been acting like an optical sieve, holding back the blue may naturally be asked, "Can our senses have so entir ceived us that they give no hint of this truth?" If we are appeal wholly to recondite scientific methods, and are th indications, at least, which we may gather for ourselve think there are, even to our unaided eyes, indications th seemingly transparent air really acts as an orange medi keeps the blue light back in the upper sky.

If I hold this piece of glass before my eyes, it seems less and transparent, but it is proved not to be so by through it edgewise, when the light, by traversing a extent, brings out its true colour, which is yellow. Eve knows this in every-day experience. We shall not colour of the ocean by looking at it in a wine-glass, but by through a great depth of it; and so it is with the air. If directly up, we look through where it is thinnest; but if horizontally through it towards the horizon, through great nesses, as at sunrise or sunset, is it not true that the air,

… the sun look very
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… of a bluish sun. In
… our atmosphere has ab-
… white reach us, I mean,
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… but more orange than red,
… an green; so that its action
… e that which you now see
… mixture of blue and white
… while letting the white fall

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… e for ever to describe the
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… ovel experiment to offer, but
… ones in a new light.

We are most of us familiar, for instance, with that devised by Sir Isaac Newton to show that white light is compounded of blue, red, and other colours, where, by turning a coloured wheel rapidly, all blend into a grayish white. Here you see the "seven colours" on the screen; but though all are here, I have intentionally arranged them, so that there is too much blue, and the combined result is a very bluish white which may roughly stand for that of the original sun ray. I now alter the proportion of the colours so as to virtually take out the excess of blue, and the result is colourless or white light. White, then, is not necessarily made by combining the "seven colours," or any number of them, unless they are there in just proportion (which is in effect what Newton himself says); and white, then, may be made out of such a bluish light as we have described, not by putting anything to it, but by taking away the excess which is there already.

Here, again, are two sectors—one blue, one orange-yellow with the blue in excess, making a bluish disk where they are revolved. I take out the excess of blue, and now what remains is white.

Here is the spectrum itself on the screen, but a spectrum which has been artificially modified so that the blue end is relatively too strong. I recombine the colours (by Prof. Rood's ingenious device of an elastic mirror), and they do not make a pure white, but one tinted with blue. I take out the original excess of blue, and what remains combines into a pure white. Please bear in mind that when we "put in" blue here, we have to do so by straining out other light through some obscuring medium, which makes the spectrum darker; but that, in the case of the actual sunlight, introducing more blue, introduces more light, and makes the spectrum brighter.

The spectrum on the screen ought to be made still brighter in the blue than it is—far, far brighter—and then it might represent to us the original solar spectrum before it has suffered any absorption either in the sun's atmosphere or our own. The Fraunhofer lines do not appear in it, for these, when found in the solar spectrum, show that certain individual rays have been stopped, or selected for absorption by the intervening atmospheres; and though even the few yards of atmosphere between the lamp and the screen absorb, it is not enough to show.

Our spectrum, as it appears before absorption, might be compared to an army divided into numerous brigades, each wearing a distinct uniform, one red, one green, one blue, so that all the colours are represented each by its own body. If, to represent the light absorbed as it progresses, we supposed that the army advances under a fire which thins its numbers, we should have to consider that for good [illegible] of nature the destructive fire was directed chiefly against those divisions which were dressed in blue or allied colours, so that the army was thinned out unequally, more men in blue being killed off for one in red, and that by the time it had advanced a certain distance under fire the proportion of the men in each brigade has been altered, the red being comparatively unhurt. Almost all absorption is thus selective in its action, and often to an astonishing degree, killing off, so to speak, certain rays in preference to others as though by an intelligent choice, and [illegible] not only of certain [illegible] continue destroying most, [illegible] certain [illegible] in each company, [illegible] has its own individuality, and on this I cannot [illegible] too strongly [illegible] for just as two men [illegible] their personalities under the same red uniform, and one may fall and the other survive, though they touch shoulders in the ranks, so in the spectrum certain parts will be [illegible] out by absorption, while others next to them may escape.

To illustrate this selective absorption, I put a piece of [illegible] glass in the path of the ray. It [illegible] of course [illegible] some of the light, but instead of dimming the whole spectrum, [illegible] we might almost [illegible] choosing a narrow narrow part [illegible] and [illegible] all the rest [illegible]. [illegible] this selecting [illegible] far more complex manner, taking out a [illegible] here and another there, in [illegible] all through the spectrum, but on the whole much the [illegible] the blue, the Fraunhofer lines being merely part of the evidence of this wonderful [illegible] action which bears the name of selective absorption.

Before we leave this spectrum, let us recall one most important matter. We know that here beyond the red is solar energy in the form of heat which we cannot see, but not on that account any less important. More than half the whole power of the sun is here invisible, and if we are to study completely the action of our atmosphere, we shall have to pay great attention to this part, and find out some way of determining the loss in it, which will be difficult, for the ultra-red end is not only invisible, but compressed, the red end being shut up like the closed pages of a book, as you may notice by comparing the narrowness of the red with the width of the blue.

Now refraction by a prism is not the only way of forming a spectrum. Nature furnishes us colour not only from the rainbow, but from non-transparent substances like mother-of-pearl, where the iridescent hues are due to microscopically fine lines. Art has lately surpassed nature in these wonderful "gratings," consisting of pieces of polished metal, in which we see at first nothing to account for the splendid play of colour apparently pouring out from them like light from an opal, but which, on examination with a powerful microscope, show lines so narrow that there are from 50 to 100 in the thickness of a fine human hair, and all spaced with wonderful precision.

This grating is equal in defining power to many such prisms as we have just been looking at, but its light does not show well upon the screen. You will see, however, that its spectrum differs from that of the prism, in that in this case the red end is expanded, as compared with the violet, and the invisible ultra-red is expanded still more, so that this will be the best means for us to use in exploring that "dark continent" of invisible heat found not only in the spectrum of the sun, but of the electric light, and of all incandescent bodies, and of whose existence we already know from Herschel and Tyndall.

Now we cannot reproduce the actual solar spectrum on the screen without the sun itself, but here are photographs of it, which show parts of the losses the different colours have suffered on their way to us. We have before us the well-known Fraunhofer lines, due, you remember, not only to absorption in the sun's atmosphere, but also to absorption in our own. We have been used to think of them in connection with their cause, one being due to the absorption of iron-vapour in the sun, another to that of water-vapour in our own air, and so forth; but now I ask you to think of them only in connection with the fact that each is due to the absorption of some part of the original *light*, and that collectively they tell much of the story of what has happened to that light on its way down to us. Observe, for instance, how much thicker they lie in the blue end than in the red—another evidence of the great proportionate loss in the blue.

If we could restore all the lost light in these lines, we should get back partly to the original condition of things at the very fount, and, so far as our own air is concerned, that is what we are to ascend the mountain for—to see, by going up through nearly half of the atmosphere, what the rate of loss is in each ray by actual trial; then, knowing this rate, to be able to allow for the loss in the other part still above the mountain top, and, finally, by recombining these rays to get the loss as a whole. Remember, however, always, that the most important part of the solar energy is in the dark spectrum which we do not see, but which, if we could see, we should probably find to have numerous absorption spaces not corresponding to the Fraunhofer lines, but where heat has been stopped out rather than light. To make our research thorough, then, we ought not to trust to the eye only, or even chiefly, but have some way of investigating the whole spectrum; the invisible in which the sun's power chiefly lies, as well as the visible, and both with an instrument that would discriminate the energy in these very narrow spaces, like an eye to see in the dark; and if science possesses no such instrument, then it may be necessary to invent one.

The linear thermopile is nearest to it of any, and we all here know what good work it has done, but even that is not sensitive enough to measure in the grating spectrum, in some parts of which the heat is 400 times weaker than in that of a prism, and we want to observe this invisible heat in very narrow spaces. Something like this has been provided since by Capt. Abney's most valuable researches, but these did not at the time go low enough for my purpose, and I spent nearly a year before ascending the mountain in inventing and perfecting the new instrument for measuring these, which I have called the "bolometer" or "ray-measurer." The principle on which it is founded is the same as that employed by my late lamented friend, Sir Wm. Siemens, for measuring temperatures at the bottom of the sea, which is that a smaller electric current flows through a warm wire than through a cold one.

One great difficulty was to make the conducting wire very thin, and yet continuous, and for this purpose almost experiments were made, among other substances pu having been obtained by chemical means in a plate so t it transmitted a sea-green light through the solid subst the metal. This proving unsuitable, I learned that it been rolled of extraordinary thinness in a contest of skill some English and American iron masters, and, procuring found that 15,000 of the iron plates they had rolled, laid the other, would make but one English inch. Here is it, rolled between the same rolls which turn out plates iron-clad, but so thin that, as I let it drop, the iron plate down like a dead leaf. Out of this the first bolomete made, and I may mention that the cost of these earlier ments was met from a legacy by the founder of the Roya tution, Count Rumford. The iron is now replaced by pl in wires or rather tapes, from 1-2000 to 1-20,000th of thick, one of which is within this button, where it is all visible, being far finer than a human hair. I will proje the screen, placing a common small pin beside it as a m of comparison. This button is placed in this ebonite ca the thread is moved by this micrometer screw, by whic be set like the spider line of a reticule; but by means cable, connecting it to the galvanometer, this thread though sensitive, like a nerve laid bare to every indi heat and cold. It is then a sort of sentient thing: what sees as light it feels as heat, and what the eye sees as a band of darkness (the Fraunhofer line) this feels as a narr of cold, so that when moved parallel to itself and the hofer lines down the spectrum it registers their presence.

It is true we can see these in the visible spectrum, remember we propose to explore the invisible also, and thus the dark is the same as the light, it will feel about i is the infra-red which might remain otherwise unknown.

I have spent a long time in these preliminary researc indirect methods for determining the absorption of ou sphere, and in experiments and calculations which I do tail, but it is so often supposed that scientific investiga sort of happy guessing, and so little is realised of the l preparation and proof, that I have been somewhat p in describing the essential parts of the apparatus fin ployed, and now we must pass to the scene of their use.

(*To be continued.*)

## THE INSTITUTION OF MECHANIC[AL] ENGINEERS

A VERY interesting discussion on the merits of the automatic machine-gun, which was described in N vol. xxxi. p. 414, took place at the special meeting of t tution held on the 30th ult. In reply to Mr. Cuthbe the inventor explained that the recoil of the gun, utilised for loading and firing, did not interfere with the of aim, and instanced the circumstance that as good target was made in firing from the shoulder as with fixed rifles the energy of recoil was sufficient to carry on the a action, whether the muzzle of the gun was elevated or de As regarded keeping the barrel cool, he found that th jacket around the body of the gun acted most effici gunpowder in exploding produced very little heat energ he put it, "he should not buy gunpowder to raise During all his experiments he had used only Governm tridges, and had never found one to fail; he thought be an advantage if cartridges were packed in cases co calcium chloride or other hydroscopic material, so t might not be injured by moisture.

The gun was frequently fired during the meeting automatic action was thoroughly shown, as well as its from danger should a cartridge hang fire. Mr Maxi most enthusiastic reception, the general feeling of the and of the meeting being in favour of the gun being by the British Government, the President and Mr. giving it as their opinion that, if the necessary shou tion of these guns could be produced weekly at a notice, when they might have as material an eff campaign as the needle-gun had at Sadowa. Mr. Max experimenting with a more recent form of gun of his which fires a projectile 3 lbs. weight at the rate of 120 minute; in this the cartridges are fed from above, wh simplifies the mechanical arrangement, as no apparatu

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viz. [illegible]

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e it has reached its final
the joint as a whole will
e corrosion only gradually
own to that of the rivets.

There is an interesting point to which we propose reference on a future occasion, viz. the probable causes to which an increase of tensile strength in the remaining material of perforated plates may be due.

The President, at the conclusion of an interesting discussion, referred to the circumstances that the paper was an abstract of three years' work, the experiments having been carried on by Prof. Kennedy free of charge to the Institution, whilst the material supplied and the work of preparing the various joints tested had been performed at private cost.

The main feature in connection with the Blooming Mill designed by Mr. C. B. Holland, of Ebbw Vale, a paper describing which was read, was the application of hydraulic power to all the work performed, except that of actually driving the rolls.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE*

OXFORD.—On Tuesday last an effort was made to relieve Honour men in the non-classical final schools from the drudgery entailed by the present Pass Classical Moderations. Council brought forward a scheme substituting a Preliminary Honour Examination in each Honour School in lieu of "Pass Mods." Under this scheme the study of the classical languages would not be required of any candidate for honours in Natural Science or Mathematics after he had passed the present Responsions or "Smalls;" thus an extra year would be given to the study of the subjects chosen for the final schools. Unfortunately for the measure, the preamble—mainly of general character—contained one clause relating to Mathematics which would have exempted mathematical class men from any literary work, and the preamble was therefore opposed by many who approved of its general policy but desired an opportunity of discussing or amending the Preliminary Examination to be introduced into each Faculty. The preamble, after a long debate, was lost on a division by one vote only—72 voting for it and 73 against. No doubt a similar measure will be brought forward again.

## *SCIENTIFIC SERIALS*

To the number of the *Journal of Botany* for March Mr. F. Townsend contributes an illustrated paper on the floral envelopes of Cyperaceae and Gramineae, in which he claims a closer homology between the corresponding parts in the two orders than has generally been allowed.—Mr. G. Murray has another and [illegible] found by [illegible] Mr. Worthington Smith in the leaves of Mr. A. S. W[illegible] and which he demonstrates not to have the [illegible] and to be unconnected with organisms [illegible].—In the number for April Mr. T. Hick gives the [illegible] protoplasm, which he [illegible] a seaweed belonging to [illegible] a [illegible]. [illegible] two numbers other additions to [illegible] local botany.

THE [illegible] in the *Nuovo Giornale Botanico Italiano* [illegible], 1885, is by [illegible] on the anatomy of [illegible]. [illegible]

these numbers are [illegible] contributions to local floras.

## SOCIETIES AND ACADEMIES

### LONDON

**Physical Society**, April 25.—Prof. Guthrie, President, in the chair.—The following papers were read:—On the theory of illumination in a fog, by Lord Rayleigh. The paper dealt with certain theoretical results based upon the assumption that the medium in which the fog was formed and the substance composing the fog itself were perfectly transparent. The effect of such a fog surrounding a source of radiation would be to diminish the radiation, and in the case of a supply of energy from without, as with the carbon filament of an incandescent lamp, the temperature of the source would be increased by the fog. A spherical envelope of such a fog surrounding the lamp, and sufficiently thick to be impervious, would act as a perfectly reflecting surface. A problem closely related to the above, and which is easily worked out, is that of light incident normally upon a pile of glass plates. If $m$ be the number of such plates, and $\rho$ the fraction of incident light reflected by one plate, $\phi(m)$ the light reflected, and $\psi(m)$ that transmitted by a pile of $m$ plates, we have—

$$\frac{\phi(m)}{2m\rho} = \frac{1}{1+(2m-1)\rho} = \frac{\psi(m)}{1-\rho}.$$

If the transmitted light be allowed to fall upon another pile consisting of $n$ plates, we have an infinite amount of reflection between the plates, and as the final result if $A$ denotes the radiation in the original direction, and $B$ that in the opposite,

$$A = \frac{2n\rho + 1 - \rho}{2(m+n)\rho} \qquad B = \frac{2m\rho}{2(m+n)\rho + 1}.$$

If $m$ and $n$ are large, we have—

$$A = B = \frac{n}{m+n},$$

which shows that by increasing $n$ we can make the radiation between the plates as much as if the first pile did not exist whatever the number of plates in it.—On a monochromatic telescope, by Lord Rayleigh. This is a modification of Maxwell's colour-box. In this instrument, as is well known, light passes through a slit in the focus of a collimating lens; it traverses in succession this lens, a prism, and another lens by which it is brought to a focus upon a plane surface in which is a movable slit, the eye being placed behind which receives light approximately monochromatic. If, in addition, a lens be placed just behind the first slit, so as to bring some distant object into focus at a convenient distance from the eye, this object will be seen by the light that would enter the eye in the simple colour-box. The author suggested the use of this instrument to compare lights of different colours, and hinted at the possibility of choosing some colour towards the middle of the spectrum at which light might be compared for practical purposes.—On the self-regulation of the compound dynamo, by Prof. A. W. Rucker. If $\phi$ represents the current or electromotive force in the external circuit of either form of compound dynamo, it is given by means of an equation of the form

$$\phi = \frac{P}{A+x} - \frac{Q}{B+x},$$

where $A$, $B$, $P$, and $Q$ are quantities which are different in different cases, but are always independent of the external resistance, and $x$ is the conductivity or the resistance of the external circuit, according as $\phi$ represents the E.M.F., or current. The constant $A$ in all cases depends only on the resistance of the various parts of the machine. If $\mu$ and $m$ are respectively the largest and smallest values of $x$ between which self-regulation is aimed at, then $\mu - m$ may be called the *range* of $x$. That value of $x$ which corresponds to the resistance most frequently used may be called the *usual value* of $x$ and indicated by $\xi$. The maximum efficiency $\eta$ of the machine is connected with $A$ and $\xi$ by the relations

$$A = \xi(1+\eta)(1-\eta) \text{ if } \phi \text{ be the external E.M.F.}$$
$$A = \xi(1+\eta)/(1-\eta) \text{ if } \phi \text{ be the external current.}$$

It can easily be shown that the function $\phi$ has two critical values, and that the value of $x$, corresponding to one of these, is necessarily negative, unless one of the inducing spirals is wound so as to diminish the magnetisation. Various cases are considered, corresponding to different relations among the magnitudes of the constants $A$, $B$, $P$, and $Q$. The following indications of the method of treatment may suffice. If $A/B < 1 < \sqrt{P/Q}$, $\phi$ is positive for all positive values of $x$, and the critical value of $\phi$ occurs for a negative value of $x$, so that $\phi$ dimin[ishes as $x$] increases. Hence, if we write

$$\frac{P}{A+m} - \frac{Q}{B+m} = \phi_1,$$

we must have

$$\frac{P}{A+\mu} - \frac{Q}{B+\mu} = \frac{\phi_1}{1+q},$$

where $q$ is a positive quantity which will be less as regulation is more perfect. These equations give

$$P = \frac{\phi_1}{1+q} \cdot \frac{\mu - m - q(B+m)}{(A-B)(\mu - m)}(A+\mu)(A+m)$$

$$Q = \frac{\phi_1}{1+q} \cdot \frac{\mu - m - q(A+m)}{(A-B)(\mu - m)}(B+\mu)(B+m).$$

Now since $A - B$ is negative, we must, if $P$ and $Q$ are [positive,] have

$$q > (\mu - m)/(A+m),$$

and *a fortiori*

$$q > (\mu - m)/(B+m).$$

By similar methods inferior limits to $q$ are found [in other] cases, and it is thus shown that for given values of $\mu$ [and $m$] the limit is lower as $A$ is larger. It has, however, been [shown] above that if the maximum efficiency of the machine is [given, $A$] will be large or small, according as it is taken from an [equation] that gives the external E.M.F. or the external [current]. Hence it is more difficult to combine high efficiency w[ith] self-regulation if an approximately constant external c[urrent is] desired than if an approximately constant external E.[M.F. is] aimed at. The equations do not lead to any simple rules [or] relations which should hold between the various parts of [a] dynamo; but if some of the constants are taken as gi[ven, the] values which must be assigned to the others can be calc[ulated for] a given efficiency for the usual value of $x$ and a given d[eparture] from perfect self-regulation between given values of $x$ [is] attained.—On the determination of the heat-capacity of [a ther]mometer, by Mr. J. W. Clark. The method consists [in the] estimation of the masses of the mercury and glass [of the] thermometer by weighing the instrument in air and in [mercury] and again in water when immersed to the extent usual [in] thermal experiments. The specific gravity of the gla[ss and] mercury being known, the absolute masses immersed [are] readily calculated, and consequently the thermal capaci[ty.—A] photometer which enabled a comparison to be made b[etween] the light of a lamp emitted at any angle and a standa[rd was] exhibited by Mr. [illegible], and the action explained b[y Mr.] [illegible], who stated that the maximum amount of illu[mina]tion took place at an angle of 45°.

**Geological Society**, April 23.—Prof. T. G. B[onney,] F.R.S., President, in the Chair.—John Rudd Leeson, [Esq.,] was elected a Fellow of the Society. The following com[muni]cations were read:—A general section of the Bagshot strat[a from] Aldershot to Wokingham, by the Rev. A. Irving, F.G.S. [The] author referred to earlier papers on the *Geological Magazi[ne]* [in] which the green colouring matter so common in the Middl[e and] Lower Bagshot strata of the London Basin had been attri[buted] to the presence of vegetable *débris* and the materials re[sulting] from decomposition of vegetable matter. The marked diffe[rence] in this respect between these strata and the higher membe[rs of] the series furnishes a clue to the conditions under which [they] were respectively deposited, the former being delta- and lag[oon] deposits, the latter the deposits of a marine estuary. Thi[s im]plies a transgressive overlap of the upper portion of the Bag[shot] series upon the London clay; and the present paper was dev[oted] to a consideration of the stratigraphical evidence of this ove[rlap.] Sections were described in detail at Aldershot, Farnborou[gh,] Yateley, Camberley, Wellington College and the neighbourh[ood] and from the last named place to Wokingham. From the[se a] general section was constructed to exact scale, both as to th[ick]ness of strata and altitudes, showing a relation of the Bag[shot] formation to the London clay which was inconsistent wit[h the] generally received view of their conformability and at vari[ance] with the mapping of the district as executed by the Geolog[ical] Survey. The importance of the Bagshot pebble-bed as a [base]ment line of the upper division of the Bagshot strata was sho[wn,] as was suggested by the author so long ago as 1880. The [syn]clinal arrangement of the London clay was shown to have b[een] produced *before* the deposition of the Bagshot sands, thoug[h]

...nt amount of 150 ...o north) has since ...oraminifera of the ... Communicated by ...

...5.—Mr. R. H. Scott, ...lowing papers were ...e of Water-Supply. ...o consideration the ...streams, and rivers, ...l-level in cultivated ...be drawn from the ...pears that the years ...50, 1854, 1855, 1858, ...84 have been periods ...the years 1817, 1825, ...t, 1866, 1873, 1877, ...hen there has been ...ter was very low in ...d of the year it was ...e water has been of ...rom existing records ...pply of this country, ...s been stored or has ...884 is confirmatory of ...periods when there is ...most immediately fol...ater. With reference ...ear from the records ...ght to which the floods ...height to which floods ...ed by river improve... floods can be got rid ...he quantity of water, ...have not at present ...—Report of Committee ...ross Fell, Cumberland. ...er inserted in the ... ...ved a number of com... helm wind. With the ...e meteorological con...nd is blowing, all the ...ved have been [illegible] ...second [illegible] ...eals with all occurrences ...to that time [illegible] ...umerous stations in the ...Meteorological Society ...nd were recorded [illegible] ...reatest frequency [illegible] ...er. On examining the ...een that, whenever the ...sterly wind, not only [illegible] ...ntire country [illegible] ...with the easterly wind. ...quiry with regard to the ...were consequently ex... 1871, to December 31 ... wind tabulated; the ...litions over the whole ...e instances in which the ...of sufficient intensity to ...on showed that, although ...generally easterly when ...ails occurs whenever the ...the inquiry has not at all ...menon in question. For it ..., are, to all appearances, ...d yet no such occurrence ...be due to the [illegible] ...it cannot possibly be, in ...mission; but it points to ...he absolute agreement of ...sibly the different hygro...ating easterly winds may ...ther or no the helm will ...ed why, even in this case, ...must, however, be borne ...only be examined, whilst ...may be intimately con...nected with the phenomenon. From the observations made prior to those started at the beginning of 1885, no idea can be formed of the behaviour of the upper currents, even at the time of the occurrence of the helm winds, far less with the occurrence of each east wind experienced. The Society has, however, provided for the extension of the inquiry in this direction in the records which are now being collected, the observers supplying observations of the upper currents by means of the clouds, as well as the direction of the winds at the surface of the earth. As soon as a sufficient number of these observations have been received, the Committee hopes to present a further report, which will tend to explain the phenomenon of the helm wind.—Results of meteorological observations made at Asuncion, Paraguay, by R. Strachan, F.R.Met.Soc.

PARIS

**Academy of Sciences**, April 27.—M. Bouley, President, in the chair.—Experimental researches regarding (1) attacks of an epileptic character excited by the electrisation of the excito-motor regions of the brain properly so called, (2) the duration after death of the excitability so produced in the brain, by M. Vulpian. The main object of these experiments, made chiefly on dogs, is to confirm the conclusion already arrived at and communicated by the author in a previous paper, that the grey cortical substance of the cerebral regions known as excito-motor centres does not play the indispensable part hitherto supposed in the production of epileptic attacks caused by the faradisation of those regions. The inference is also confirmed [illegible] amongst the higher mammals under normal conditions the cerebral substance [illegible] loses its excitability as soon as the circulation has completely ceased in the nerve-centres.—[illegible] observed, and tabulated at the Observatory of Marseilles, by M. E. Stephan.—Results of the boring recently carried out at [illegible], in the Grand Combe Valley [illegible], by M. Grand' Eury. [illegible] 1874, by M. [illegible] checked, and the [illegible]

[illegible]

where [illegible] for the longitude of [illegible] planet 240 [illegible] March [illegible] Marseilles, Vienna, [illegible] March 28 at [illegible] and Vienna, on March 31 at Boston and on April 9 at [illegible] [illegible], by M. [illegible] position of [illegible], by MM. [illegible].—A direct and simple demonstration of M. [illegible] "helicoidal" [illegible], by M. A. [illegible].—Note on a method of [illegible] the velocity of [illegible], by M. M. [illegible] illuminating [illegible], by M. A. [illegible] connect the so-called "Bishop's" ring [illegible] to the Krakatoa eruption in 1883, 1884, and 1885, by M. F. A. Forel.—[illegible] a method of reproducing at pleasure a large number of [illegible] phosphates [illegible], by M. H. [illegible].—[illegible] of [illegible], by M. A. [illegible] this paper [illegible] conditions under which were produced the [illegible] in certain [illegible] the same [illegible] sulphate of copper, and on [illegible] basic sulphate of [illegible], by M. G. [illegible] the [illegible] MM. [illegible] and [illegible] on the chemical constitution of [illegible], by MM. [illegible] and [illegible].—Studies on the inhalation of [illegible] chloride of methylene and of tetrachlorometted formene (perchloride of carbon), by MM. J. Regnault and Villejean.—On the effects produced on man and animals by the stomachic ingestion and hypodermic injection of the [illegible] associated with the diastasic liquid of cholera, and cultivated in peptonised gelatine, by M. Rorhefontaine. Experiments made by the author on himself and on the guinea-pig tend to show that these preparations, when swallowed or injected in small doses, produce no morbid symptom, although large doses may give rise to more or less serious local inflammation. He infers that the physiological disorders observed in cholera patients are due, not to the development of the microbe germs, but to the presence of a special substance not yet determined; further, that in its normal state the blood of man and other animals is destructive to the cholerаic microbes artificially prepared in gelatine.

BERLIN

**Physiological Society**, March 27.—Prof. Ewald spoke on the occurrence of lactic acid in human gastric juices, which was now universally regarded as a pathological formation, *i.e.* a product of fermenting processes which did not obtain under normal conditions. In conformity with this opinion he had, in a former investigation, clearly demonstrated the absence of lactic acid, even after milk had been partaken. On the other hand, he had regularly found hydrochloric acid in the gastric juice. Two cases of hysteric vomiting, which had come under his observation in the infirmary, induced him to resume this investigation, one of the cases especially inviting such inquiry. The female patient was able to retain on her stomach and normally digest solid food, but whenever she swallowed anything fluid the whole contents of the stomach were at once vomited. Opportunity was, therefore, here offered at any time to examine the contents of the stomach after food had been received. Prof. Ewald mentioned the different chemical reactions by means of which the presence of lactic acid might be easily detected in the gastric juice, and among them he deemed carbolic acid and chloride of iron the most trustworthy. He then described the experiments he had carried out on the female patient above referred to, which had yielded the following results:—After a mixed meal (of bread, vegetables, and meat), lactic acid was found 26 times out of 31 in the contents of the stomach in the space of 10 to 100 minutes after the reception of the food; in 5 cases, however, not till 120 minutes or more after that point of time. Hydrochloric acid was found in the contents of the stomach only in the second hour and later, after the lactic acid had disappeared. Out of 26 cases in which white bread was alone eaten, lactic acid was demonstrated in 17 cases, occurring in 10 to 100 minutes from the time of eating. Out of 15 cases in which cooked albumen was administered, lactic acid was found only in one case, within one-and-a-half hours from the time of its being taken; while, on "schabefleisch" (scraped raw meat) being administered, lactic acid became again demonstrable; in the majority of cases in 10 to 100 minutes' time. From these experiments it was to be inferred that lactic acid occurred normally in the contents of the stomach, namely, in the first period of digestion. It was, however, in the opinion of Prof. Ewald, no normal constituent of the gastric juice, but in the case of a mixed and meat diet originated in the sarco-lactic acid obtained from the meat and, in the case of white bread being taken, from the fermentation of the starch. On albumen being taken, lactic acid was, therefore, not found, because it occurred in the stomach only when it was introduced with the food—in the case of meat, for example—or when it arose from a fermentative aliment. With reference to the ulterior issues of the lactic acid, the speaker adopted the view of Prof. Maly, that it was employed towards the formation of the free hydrochloric acid afterwards appearing in the gastric juice. Dr. Blaschko reported some observations he had made on sensations of pressure. In the course of investigations into the development of the skin, he had found that the hair-roots were provided with a rich nerve plexus in the same manner as the touch corpuscles in the touch balls of the hands and feet, and this induced him to examine the hairs in respect of their sensibility to pressure. When he took a stiff hair a little curved at the tip, and stroked the skin with it, he had only then a sensation when he touched a lanugo hair. By this and other means he became convinced that the hair papillæ possessed such a high degree of sensibility as entitled them to be placed in a series with the touch papillæ. While, however, the touch corpuscles had to be drawn hither and thither over the object to be touched, in the case of the touch hairs the body to be felt had, on the contrary, to be waved over it. Dr. Blaschko was therefore of opinion that a direct and an indirect, or a papillary and a ciliary feeling of the skin had to be distinguished. The first performed its functions at the unhaired cutaneous spots; the touch balls of the hand, an[d] and at the lips; by means of the touch corpuscles. T[he] or ciliary sensations, on the other hand, were perfor[med] lanugo hairs covering the whole body, which wer[e], therefore, touch hairs. If at a l[...] ed spot of the sk[in] the forehead, the lanugo hairs were shaved away, [...] the fine sensations of [...] ure likewise disappear, and that part of the skin with the stiff hair above referre[d] respondingly large hiatus would become perceptible nothing would be felt. In the course of this investi[gation the] speaker had failed to convince himself of the existence [of] points of pressure, and controverted the doctrine set [forth by] Goldscheider in the former sitting of the Society resp[ecting] specific energies of the nerves of feeling, and their [...] distribution over the surface. In the discussion which Dr. Goldscheider maintained the accuracy of his for[mer state]ments, and invited Dr. Blaschko to convince himsel[f of its] correctness according to the method prosecuted by him.

VIENNA

**Imperial Academy of Sciences**, February 5.—[Contribu]tions to general nerve and muscle physiology (seventee[nth com]munication): on the electric stimulation of the sph[incter of] Anodonta, by W. Biedermann.—Experiments on the [...] of albumen by potassium permanganate, by R. M[...] *Clemmys sarmatica*, nov. spec., from the Hernalser [...] Vienna, by C. A. Penschke.—Remarks on the velocity [...] in quartz, by K. Exner.—Histological and embryolo[gical re]searches on the uro-genital apparatus, by T. Tanneik[...] new vegetable parasite of the human body, by R. von W[...]

February 12.—On the bloodless-vessels in the tail of fr[og] larvæ, by S. Mayer.—On the construction of intrinsic [...] T. Schroder.—On the isogyric plane of double-refracti[ng crys]tals, by H. Pitsch.—On the geographical distribution [...] Jurassic formation, by M. Neumeyr.

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From the year 1848 and onwards there follows a long series of important investigations into the fundamental problems of thermo-dynamics. These start first with Saadi Carnot's conclusions respecting the mechanical functions of heat arrived at before J. P. Joule had experimentally demonstrated the equivalence of heat and mechanical energy. At the time when Carnot published his investigations heat was, by the majority of physical scientists, deemed an imponderable substance capable of flowing from one body to another, of entering occasionally into a more intimate kind of union with ponderable matter, and becoming, so to say, chemically united with it, under changes in the state of aggregation and under chemical processes. According to this older view temperature signified as much as the pressure under which the imponderable fluid stood in the warm bodies. In the case of a great number of thermal processes heat, in point of fact, acts entirely like a substance, showing the constancy of quantity, which is the most characteristic criterion of substances. In this way large sections of the doctrine of heat, embracing great bodies of facts, could very well be treated under the substantial conception of this agent—such, for example, as the exchange of heat between different bodies, the confinement and liberation of latent heat, the chemical production of heat. All that was necessary to render the substantial conception of heat apparently satisfactory was but to leave out of account all cases in which other forms of work are produced by heat or in which heat is produced by such. Cases of this kind then known were indeed very few, whereas the sections of the doctrine of heat already referred to were exactly those which till towards the middle of this century engaged the attention of natural philosophers. Carnot's highly acute investigation was an attempt to bring the phenomena likewise of the performance of work by means of heat into harmony with the assumption of the substantial theory of heat. The result of this endeavour was remarkable enough. He showed, namely, that heat was capable of performing mechanical work only when a quantity of it passed from a body of higher temperature into another body of lower temperature. A complete analogy thus seemed to be established between heat and those gases which through their pressure are capable of performing work, expanding, as they do, and lowering their pressure in a measure corresponding with their expansion. The heat of a warm body corresponds in a manner with a compressed gas: it diffuses itself in space, passing into neighbouring bodies, to the lowering of the temperature of the body in which it was originally [illegible].

Carnot's deductions, although based essentially on the erroneous assumption that the quantity of heat was constant like that of a substance, proved in reality correct so far as they respected [illegible] of heat within very narrow limits of temperature. They cease, however, to be strictly accurate when they are extended to wider intervals of temperature, for in this case finite parts of the transferred heat become transformed into work and no longer continue as heat. We now know through the experiments of Joule [illegible] not [illegible] the absolute constancy of a substance, but only the relative constancy of an equivalent of work which, to be sure, can neither be produced from nothing nor come to nothing, but is yet capable of being transferred into other forms of equivalents of work which may be presented in a very diverse and hardly recognisable manner.

In his first Essays, Art. XXXIX., "On an Absolute Thermometric Scale," and Art. XLI., "An Account of Carnot's Theory of the Motive Power of Heat," dating from the years 1848 and 1849, our author still occupies essentially Carnot's standpoint, but he nevertheless calls attention to the fact that the argument adduced by Carnot in support of his theorem, apparently valid though it was in all points, was yet defective if the experiments by Joule, which were just then made known, should be confirmed, according to which heat might be generated anew by work (vol. i. p. 116). That which more immediately directed Sir William Thomson's studies to this subject was the possibility of attaining, in accordance with Carnot's theorem, to an absolute scale of temperature, and he endeavoured to utilise the observations which Regnault had shortly before carried out with special care in reference to the pressure and latent heat of steam for the purpose of calculating such a scale. But in doing so, he was obliged to apply the hypothesis, not perfectly exact in this case, that the density of steam was to be calculated from pressure and temperature according to the laws of gases.

The theory of Carnot next obtained highly surprising confirmation from the theoretical deductions drawn by Prof. James Thomson, the elder brother of Sir William, touching the alteration of the freezing-point of water in consequence of differences of pressure. The accuracy in point of fact of this deduction was experimentally demonstrated by Sir W. Thomson. This was a discovery which perhaps more than any other served to draw the attention of physical scientists to the accuracy and the importance of Carnot's theorem.

Meanwhile our author, no longer able to doubt the correctness of Robert Mayer and Joule's thesis respecting the equivalence of heat and work, devoted himself to the problem of how Joule's and Carnot's laws might be combined. This question he answered in his treatise of March, 1851, "On the Dynamical Theory of Heat," Art. XLVIII. Prof. Clausius, in Germany, had, however, been busied with the same problem, and had published the results at which he arrived before Sir W. Thomson, in May, 1850. The essential results of the two investigations coincided exactly; only in their numerical values for the absolute scale of temperature, the two authors had started with two different hypotheses, and had therefore reached different conclusions. Sir William Thomson had, as above mentioned, calculated the density of steam from pressure and temperature, as if for complete gases, whereas Prof. Clausius had accepted the hypotheses set up by Robert Mayer, according to which the work of a gas expanding itself was exactly equivalent to its loss of heat. Later on, when his opponents set forth the unsatisfactory basis of this hypothesis, Robert Mayer pointed to an old and very little-known experiment of Gay-Lussac, according to which a gas diffusing itself in empty space without encountering any resistance suffered no diminution of heat. The same experiment was afterwards carried out by Joule without his having any knowledge of the earlier observation of a similar nature. This form of the experiment was, however, as a whole, not fitted to yield very precise results, seeing that the mass of

air available for it, whose consumption of heat
measured, was necessarily very small in comp
the mass of water of the calorimeter. It was
investigations into the changes of temperature
by a mass of gas made to pass through a
porous substance—an investigation carried out
by J. P. Joule and Sir W. Thomson, in 1852, and
in Art. XLIX., "On the Thermal Effects of
Motion"—that it was demonstrated how, in po
R. Mayer's hypothesis was accurate to with
close degree of approximation, although not
lute precision, in respect of hydrogen and atmos
whereas carbonic acid showed greater deviation

To this have to be added extended investiga
thermo-electric currents, and the equivalent
operations (Appendix to Art. XLVIII. and
"Experimental Researches in Thermo-electricit
Art. XCI. Bakerian lecture, pp. i., ii., and iii., Vo
a thermo-electric chain which, from its conduc
sets magnets in motion, or generates heat in
heat conducted to the soldering seams is man
source of the operations. We know that in su
according to the important observations of Pe
disappears from the warmer soldering seam, and
developed in the colder. That is, in fact, the c
according to Carnot's law, under which heat
transferable into other forms of work. This
process was, however, of special interest for the
validity of the theory, seeing that the work of he
produced under conditions altogether different fr
of the steam-engine and hot-air engine. Our au
by this investigation led to the conclusion that, co
the opinion hitherto entertained, it was not in th
ing-seams of the metals, at all events not in th
but in the whole length of the wires, by a proce
he calls "electric convection of heat," that the
cause of the thermo-electric force was to be soug
In point of fact, he succeeded by a series of very
and subtle experiments in demonstrating that the
tion of heat in iron proceeded more rapidly in the
of the current of negative electricity, and in copp
direction of the positive current.

In the first volume of the book which is the s
notice, the consecutive stages may thus be follow
development of one of the most remarkable chapte
history of discoveries, a chapter specially remarkab
an example of how discoveries are arrived at in a
not always rational. The course of this disco
minds one in some measure of the invention of
atic telescopes. Starting with the erroneous sup
that the eye of man was achromatic, Euler infer
Newton's assumption of the proportionality
refraction and dispersion of light was false, a
his conclusion as to the impossibility of ach
telescopes was without foundation. Thereupon
gave the receipt for the making of achromat
scopes—a correct conclusion from a false p
similar to the case of Carnot with the doctrine
After all the confirmations which have been obta
the different branches of physics for the valid
deductions of the corrected Carnot law there ca
longer remain any doubt that we have here foun
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principle in question could have been deduced from the more correct view, namely, that heat is motion, seeing that we are not yet in a position to establish that view on a completely scientific basis. The two natural philosophers, moreover, who brought Carnot's and Joule's principles into harmony with each other, and whom we have to thank for our present knowledge on this subject, are able to refer their conclusions only to an axiom generalising the experience that heat tends ever to expand, never to concentrate. Sir W. Thomson expresses this axiom in the following terms: "It is impossible by means of inanimate material agency to derive mechanical effect from any portion of matter by cooling it below the temperature of the coldest of the surrounding objects."

The reviewer has, further, succeeded in demonstrating that the peculiar limitation affecting the transformation of heat into other forms of work likewise applies to other classes of motions revolving on themselves, so long as no external forces are brought into play directly opposing or accelerating the internal motion.[1]

When by J. P. Joule's experiment it was demonstrated that the basis of Carnot's proof was defective, it might have been apprehended that along with the element of error the element of truth in it would also be rejected. It must therefore be regarded as a special merit on the part of Prof. Clausius and Sir W. Thomson that, while removing the mistakes, they brought the truth into precise expression and into universal recognition, and that the recent theory of heat has become so fruitful in discoveries respecting the most secret connections between the different physical qualities of bodies in nature.

The second volume of these Reprints contains chiefly the researches having relation to the laying of the first submarine telegraph cable. The motion of electricity in these cables undergoes a peculiar retardation in consequence of the fact that the conducting wire separated from the sea water, which is likewise a tolerably good conductor, only by a thin isolating layer of gutta-percha, forms an enormous Leyden jar, which must first be charged with the electricity entering it before the current will pass with full force along the whole length of the wire to the other end. The physical laws of the processes which here come into play were generally known, but a far-searching mathematical investigation was still needed to determine the whole procedure of these currents and to ascertain the amount of influence exercised on them by the dimensions and conductivity of the wire, by the neighbourhood of other wires, and by the particular quality of the gutta percha, as also to arrive at a knowledge of the conditions under which the most rapid series of signals might be transmitted and received at the opposite end.

All these questions our author disposed of thoroughly and exhaustively, having [illegible] content with [illegible] to his views based on observations made under restricted conditions on [illegible]. He was then a comparatively little-known young man, [illegible] everywhere [illegible] tion and authority [illegible] mechanical problems connected [illegible]

In this were [illegible] mechanical [illegible] and [illegible] of with the sinking or eventual raising and [illegible] of

[illegible]

the cable; further, the construction of telegraphic signal apparatuses able to utilise the first weak beginnings of the current arriving at the other end of the cable. These ultimately led to the invention of the siphon-recorder—a writing apparatus in which the tube containing the ink does not come into immediate contact with the strips of paper on which it has to write, and is therefore not hindered by friction from moving even under the least electro-magnetic impulse. By electric charges it is brought about that the ink spurts over the paper in a series of fine points.

The conclusion of the second volume is formed by the Bakerian Lecture for 1856, which gathers up the results of the author's investigations into the qualities of metals as displayed under the conduction of electric currents, and under magnetisation, and the changes they undergo in consequence of mechanical, thermal, and magnetic influences.

Let us hope for an early continuation of this interesting collection. There are still nearly thirty years of scientific activity on the part of the author to be accounted for. When we think of that we cannot fail to be astonished at the fruitfulness and unweariedness of his intellect.

HERMANN L. F. HELMHOLTZ

## OUR BOOK SHELF

*Paradise Found. The Cradle of the Human Race at the North Pole. A Study of the Prehistoric World.* By William F. Warren, S.T.D., LL.D., President of Boston University, &c. (London: Sampson Low and Co.)

IT has come to be an understood thing that when geologists or biologists propound theories as to past stages of life on the earth, and these theories attain to a certain popularity, some theologian shall twist the words of the Book of Genesis into a new interpretation, to show that this was what the inspired author meant all the time. A fresh musician has set Moses to dance to a new scientific tune. Since the publication of well-known modern views as to the diffusion of plants and animals from the Polar Region, it was to be expected that we should have a book proving that man was created in an Arctic Paradise with the Tree of Life at the North Pole; and here the book is. Other ancient cosmologies, such as the Greek and Indian, are made to bear their not always willing testimony. Those who take up the book should notice that the commendatory letters published from Professors Sayce, Tiele, and Whitney do not at all imply that these eminent scholars countenance the Polar Paradise doctrine. The President of Boston University seems to have sent them a paper some years ago on "Ancient Cosmology and Mythical Geography," their acknowledgments of which they are now perhaps hardly delighted to find figuring as certificates in a "Paradise Found."

*Epping Forest.* By Edward North Buxton, Verderer. (London: Stanford, 1885.)

THE public generally, and especially the people of London, and those who take some interest in natural history, are to be congratulated on the acquisition of so charmingly complete a little itinerary of Epping Forest as that now issued in a cheaper form by one of the Committee of Conservators, who is a resident on the borders, and an enthusiast as to the attractions of the Forest. It is, as the author observes in his preface, "hardly a desirable state of things" that so small a percentage of the summer visitors to the Forest "ever venture far from the point at which they are set down by train or vehicle;" and, with the choice of a score of
beautiful walks, described in Mr. Buxton's boo[k]
guidance of his six carefully prepared maps, five
are on the scale of three inches to the mile, th
longer any reason for their not venturing i
depths of the Forest in which its chief beauties
seen. The chapter on the history of the For
the author has wisely prefixed to the itiner
visitors may be reminded of the events whic
this magnificent playground for their enjoy
most complete, though it is to be regretted tha
City Solicitor, Sir Thomas Nelson, is not men
*name* on p. 22. The practical character of the
be gauged from the inclusion of railway time-ta
fact that the distinctive letters of each route h
cut on trees at some points, and from such su
as that an east wind is, in Epping Forest, the
views, because not smoke-laden. Personal ex
has convinced the present writer of the skill wi
the routes have been selected; the "objects of
within and around the Forest," and their histori
cations, are fully described and illustrated
excellent drawings, the latter by Mr. Heywood;
but what must render the work peculiarly gratify
lovers of nature, is the ample space—more than
volume—devoted to the fauna and flora of the
The mammals, reptiles, birds; the chief mo
butterflies; the trees, flowering plants, ferns, fu
mosses, are all enumerated, with general, *i.e.*
specific, localities; and the notes on the mamm
birds will be of interest to naturalists in other
Such lists can, fortunately, never be complete;
marked as "rare" are notoriously liable at any
prove common. even since the publication of th
evidence has been produced suggesting the add
*Sparganium neglectum* to the list of flowers, a
year's cryptogamic meeting of the Essex Field C
as yet added several species to the catalogues
lower plants. There may yet be room for a mo
tentious monograph of Epping Forest, and, of
from the naturalist's stand-point, so rich a col
ground affords material for a library of expositor
ture—the freshwater algæ, for example, call for
tion;—but, for its purpose, the present work could
have been executed in a manner more creditable
author and publisher.

G. S. Bou

*Traité de Minéralogie appliquée aux Arts, à l'In[dustrie], au Commerce et à l'Agriculture, &c.* Par
Jagnaux. Avec 468 figures dans le texte.
Octave Doin, Éditeur, 1885.)

THIS work of 883 pages, as is stated in a title-p
corresponding length, is intended for the use of
students in their preparation for a degree in the s
of engineering, chemistry, metallurgy, &c. We
think that in its purely scientific contents it is likel
of advantage to English students. The first part, d
to the subject of crystallography, is rather incomple
unsatisfactory, even if regard be had to the main p
of the work. As usual, in the figure of Wol
goniometer the crystal is represented as adjusted in
that every practical student is immediately tau
avoid. Nor will the chemical formulæ meet wit
favour of English students: though the atomic weig
oxygen and silicon are given as 16 and 28 respect
silica appears throughout as $SiO_2$, water is still HO,
to nitre is assigned the formula KO, AzO$_5$. Furthe
ordinary symbols for the atoms are occasionally, as i
forty-nine formulæ of pp. 423-5, used to signify equiv
proportions of the oxides; olivine, for instance,
given as (Mg, Fe)Si. The classification is lik
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immediately follows the oriental chrysolite, a pre
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peasant; and at its first step he exclaimed: "it is a cow." I tried him, then, several times, and never found him in fault. He affirmed that cows and oxen do not lift their legs in the same way. May I request your rural readers to tell us whether that remark applies to English cattle? When on the Atlantic a sail was announced for the first time, I could perceive nothing, because I had not yet learnt what kind of a hazy thing I should distinguish. Having then sharp eyesight, I succeeded after a short practice, in discerning distant sails before any of my companions, and could turn tables on them by repeating their own saying, "*Ça crève les yeux*."

To your lore on far-sightedness in vol. xxxi. p. 506, allow me to add two instances. Zach saw from Marseilles, Mount Canigou (2700 m.), at a distance of 158 English miles; he had calculated the true azimuth beforehand, and says that the peak bursts into view at sunset. Sir W. Jones informs us that the Himalayas have been seen at the great distance of 244 miles. I quote this from Carr's "Synopsis," a useful volume, which I regret to see behindhand in many cases since the death of its clever author.

May I intrude here a comment on our mysterious sunglows? My companion having a nice eye for discriminating colours, has confirmed my notion that on rising from the horizon the successive *nuances* of fiery red, faint red, rose, mallow, prussian blue, and green, are *not* the same on consecutive days, although thermometer, barometer, and wind have not changed. This suggests the hypothesis either that the lower strata of our atmosphere undergoes changes otherwise unperceived, or that there are maxima, minima, and perhaps regular epochs in the phenomenon. To those who, unlike myself, remain stationary under a rainless sky like that of Egypt, I would recommend a careful record of these changes, at least during a few months.

Cairo, April 22 ANTOINE D'ABBADIE

## Plutarch on Petroleum

THERE is in "Plutarch's Lives," in the life of Alexander, an interesting notice of the petroleum of Media; I have not found any mention of this passage in "Plutarch" either in encyclopædia or chemical dictionary; I trust, therefore, that you will give me the opportunity of reproducing it in NATURE. I transcribe the passage from the translation of John and William Langhorne (9th edition, London, 1805).

". . . and in the district of Ecbatana he [Alexander] was particularly struck with a gulph of fire, which streamed continually as from an inexhaustible source. He admired also a flood of naphtha, not far from the gulf, which flowed in such abundance that it formed a lake. The naphtha in many respects resembles the bitumen, but it is much more inflammable. Before any fire touches it, it catches light from a flame at some distance, and often kindles all the intermediate air. The barbarians, to show the king its force and the subtlety of its nature, scattered some drops of it in the street which led to his lodgings; and, standing at one end, they applied their torches to some of the first drops, for it was night. The flame communicated itself swifter than thought, and the street was instantaneously all on fire."

W. H. DEERING

Chemical Department, Royal Arsenal, Woolwich, May 6

## Hut Circles

THE remains of the ancient British habitations on the downs on both sides of Dunstable are fairly well known to archæologists. I have often wished to expose the floor of one or more of these circles, as the task could be accomplished with a spade in an hour or two. It is, however, far better that the remains should be left alone, as it is not likely that anything would be found beyond a few flakes and the other simple forms, such as are abundant in the cultivated fields close to the huts.

On passing some of the circles on the east side of Dunstable, in the railway, about ten days ago, I noticed that the remains were covered with whitish soil instead of the normal green of the short pasture belonging to the downs. Thinking that some persons had been digging at these antiquities, I took an early opportunity of going to the spot. On reaching the circles I found they had been undermined in every direction by a large number of moles. A great deal of the material from the actual floors had been brought to the surface, and on examining the chalk rubble—for such it was—I had no difficulty in securing two or three handfuls of flint flakes. Mingled with them were a very few stones, which had been reddened and crackled by fire. No trace of burnt wood, ashes, or bone could be seen. It was remarkable that nearly all the stones found were flakes, so very few unworked pieces of flint could be lighted on. The flakes from the huts differ in condition materially from the flakes in the fields below, as all the flakes in the fields are marked with dark ferruginous strains, whilst those from the hut floors are perfectly unstained, no iron having ever reached them.

In the immediate neighbourhood I have at different times found a large number of scrapers, a lance head, a few arrow-heads, and a few rudely chipped celts, some broken. One small chipped celt has incurved sides, indicating, as Mr. John Evans has pointed out in his work on stone implements, that this particular form was possibly an imitation in flint of an early, flat bronze celt.

It is always well to examine the earth brought out of holes by rabbits, moles, foxes, rats, and other animals, in places where prehistoric relics exist on pasture land. I have secured a considerable number of my antiquities from such places.

Last year I told a young niece of mine to keep a watch on such places at the spot where the five large tumuli are placed on Dunstable Downs, and where I had on previous occasions found flint flakes in the heaps made by moles, &c. It was not long before my niece lighted on two pieces belonging to the back part of a human skull. They had been scratched out of the base of the northernmost tumulus by some animal. Fortunately the two pieces fitted together; they are evidently of great antiquity, and probably represent part of the person who was buried in the tumulus, quite possibly one of the old chippers of Neolithic implements. WORTHINGTON G. SMITH

### A Lady Curator

IN NATURE for November 27, 1884 (p. 93) you acknowledge the receipt of the "Catalogue of the Natural History Collections of the Albany Museum, Grahamstown, Cape of Good Hope," and allude to the "zealous curator." Are you aware that that individual is a young and accomplished lady? Here is another path opened for our daughters and "sweet girl graduates" to fame and fortune. Those who, like myself, have the pleasure and privilege of knowing and corresponding with Miss Glanville can appreciate the ardour and zeal with which she is following up her chosen vocation. May every success attend her. E. L. LAYARD

British Consulate, Noumea, February 25

### Hoar Frost

A COMMUNICATION in NATURE of January 8 (p. 216), in regard to frost-formations, leads me to send a word from Maine. I have seen frost-work so like the description there given, that it would answer very well for an account of forms in this climate. These frost-formations occur when the wind is chilly and blowing steadily, without the compass veering, for hours. I have compared these deposits to the most delicate designs of Oriental lace-work. At one time I witnessed an accretion on a wall, where the feathery forms were from two to four inches in length, with the points towards the wind. I think this is because each added particle adhered to the very tip of the previous one. Certainly no pen description can do justice to the delicate beauty when the sun suddenly broke through the clouds and shone upon this forest of frost ferns. CAROLINE W. D. RICH

Auburn, Me., April

### Rainbow Phenomenon

ON Saturday night, about six o'clock, I observed, at Old Trafford, on the west side of Manchester, a rainbow with accompanying phenomena, which I had never observed before. Several very heavy showers had occurred during the day. The wind was within a point or two of west. At the hour above named a cloud was passing over, very dense and uniform in colour, and with that dark leaden hue so general in thunder-storms. There was, however, no thunder or lightning. Rain fell in torrents. As the cloud, which was of large area, passed off, the sun shone brightly in the north west, and a magnificent rainbow painted itself on the dense black screen afforded by the cloud. The rainbow was double, the prismatic colours, of course, occurring in reverse order in the outer bow. The most remarkable feature of the display was the sharp contrast in the shadow of the cloud, evidently caused by the rainbow the two bows it was of the densest leaden hue. Ins bow it was exceedingly light coloured, with the faintes of luminosity. Outside the outer bow it was of an grey. The uniform mass of cloud was marked off bows with geometrical accuracy into three regions, ea homogeneous in itself, but distinctly contrasted w other tints. The effect was weird and startling, a served and commented upon by several spectator company I was. There was another feature connect inner bow which I have never observed before. The violet colours were repeated inside the bow. Th whole tract from green to violet inclusive was repe could only make out those two colours distinctly.

Have these peculiarities, either or both, been obser and, if so, how are they accounted for? CHARLE

Prestwich, near Manchester, May 11

## FIVE MATHEMATICAL RARITI

A BRIEF reference to some recent repr by Dr. Bierens de Haan, of Leyden, be unacceptable, though, unfortunately, ignorar language in which four of them are written pre giving more than the barest description of them.

The "Stelkonstige Reeckening van den Regen Algebraical Calculation of the Rainbow, is a by no less distinguished an author than B. de Spi was for a long time supposed to be lost, if not burn here printed in exact facsimile from a copy pub the Hague in 1687. Bound up with it is anoth similarly printed, entitled "Reeckening van Kan Calculation of Chances. No reference to this is Todhunter. There is a slight probability of having proceeded from the same hand, as Dr. cites a reference to the forty-third letter in the works of Spinoza.

The third reprint is of a very rare book by A. "Invention nouvelle en l'Algèbre, tant pour la des equations, que pour recognoistre le nombre tions qu'elles reçoivent, avec plusieurs choses necessaires à la perfection de ceste divine (Amsterdam, 1629). M. Marie writes: "Cet ouv surtout remarquable par les idées justes que l'aut au sujet des racines négatives des équations et usage en géométrie."

The last two tracts have not been before printe are both the work of Simon Stevin, and are entitle de Spiegeling der Singkonst" (*i.e.* Miroir de Chant), and "Vande Molens." There is a full prefixed to the former of these works, and we le the latter contains "le calcul de 19 moulins suivant la méthode usitée et suivant une nouvelle m de Simon Stevin lui-même, qui consista à modi roues, les dents et les pignons, afin de satisfaire ques conditions données."

Thanks are due to Dr. de Haan for the great ca which he has brought out these *facsimiles*, and w he will certainly reap the reward he seeks. W his words in the last of these volumes "J'ose que la reproduction de ces ouvrages d'un hon renommé pourra intéresser ceux qui s'occupe l'histoire des sciences."

## ON CERTAIN SPECTRAL IMAGES PROD BY A ROTATING VACUUM-TUBE

THE beautiful effects produced by the rotatio vacuum-tube when illuminated by a series o trical discharges from an induction-coil are well k The tube is generally attached to a horizontal axis, is turned rapidly by means of a multiplying whee images due to successive discharges which, if the were at rest, would be superposed, are thus caus occupy different parts of the retina, and if the disch

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n that a person who real-
will at first be able to

re the appearances last described, even when he knows exactly what to expect. They belong to a class of phenomena which in ordinary life we habitually train ourselves to disregard, and our persistent neglect makes it difficult to perceive them when we desire to do so. With a little patient attention the difficulty will probably disappear.[1] It was probably owing to my constant habit of studying visual impressions that the appearance of the ghost attracted my notice in the first instance.

The series of phenomena seem to be due to an affection of the optic nerve which is of an oscillatory character. Abnormal darkness follows as a reaction after the luminosity, and again after abnormal darkness there is a rebound into a feebler luminosity. Following this idea I have endeavoured to detect the existence of a second ghost as the result of a further rebound, but hitherto without success.

It is an interesting fact, as proved by these experiments, that the formation of a spectral image does not occur until the expiration of a measurable interval of time after the exciting cause has ceased to operate.

SHELFORD BIDWELL

## *JUPITER*

DURING the present opposition of this planet, the details of the belts and spots have continued to furnish materials of great interest. Some very obvious modifications have occurred since the previous year, and several curious new features have become conspicuous. The great red spot has surprised us by its extended duration. As early as 1882 it lost such a considerable depth of tone that its obliteration seemed imminent, but it has lingered on, until now its existence appears likely to be indefinitely prolonged, though under visible conditions far less imposing than at an earlier stage. All that at present remains of this remarkable formation is a dusky elliptic ring, darkest at the following end, and only well seen under good definition. Whether this ellipse is identical with similar appearances delineated by Dawes in 1857, Huggins in 1858, and Lassell in 1869, 1870, and 1871 is involved in doubt, because of the lack of intermediate observations. We have no definite information as to what became of the various objects alluded to. It is very possible that they severally represent an object of considerable permanency. The changes such as observed may have been induced by atmospheric interference. There is every indication that the dense vaporous envelopes of this planet are rapidly variable, especially in the zone included by the two equatorial belts, and that the chief features undergo singular fluctuations, some of which may possibly be of periodical character.

The particular objects drawn by Dawes and others suggest a close relationship to the red spot as it now appears. There is far from being an actual coincidence either in the positions or forms of the features here sought to be connected, but small differences must actually occur in results based on estimation. A sufficient likeness is established between them to show that further investigation may have an interesting outcome as affirming the theory of recurrent outbreaks of [illegible] pre-existing [illegible]. There is, however, an inability to trace the history of these singular objects, owing to the meagre number of observations available. This is a circumstance much to be regretted. Markings of specially interesting character deserve something more than mere record. They should be persistently watched during several oppositions, if possible, for it is only by the continuity of records that the really important questions affecting them admit of settlement. The red

[1] [illegible]

spot has now been followed since 1878, and though apparently on the verge of absolute extinction, it may yet linger on a considerable time in its present feeble aspect until possibly it is again enabled to obtrude upon general notice as an object of great prominence. It may not return under precisely the same outline as formerly, or exhibit the same depth of tone or degree of colouring, for, doubtless, some new development is to be anticipated on this disturbed region of the planet. In case of any distinct reappearance it will be important to determine that it occurred from the exact position so long tenanted by the old spot. The motion of this feature has been so thoroughly followed during the last seven years, that it will be feasible to compute its predicted place with great nicety in future months. In the mean time, and until the spot finally withdraws from reach, the same necessity exists as before of recording the times of its passages across the central meridian of Jupiter. And even assuming the total extinction of the spot, and that its place immediately south of the great equatorial south belt should resume the unbroken zonal arrangement existing in other longitudes, it will be necessary to re-examine this region occasionally for traces of any subsequent outbreak from the same focus.

During the last three years this object has given a rotation period of 9h. 55m. 39·1s., which has been steadily maintained throughout each opposition, subject to some minor disturbances partly due to errors of observation. The first few years of its existence it showed an increasing retardation of motion, which lengthened the period from 9h. 55m. 34s. to that already quoted, but, contemporarily with the decay of the spot in 1882, the velocity ceased to slacken, and the results accumulated during the past few oppositions prove it to have been equable in a marked degree.

With reference to the equatorial white spot some striking phenomena have been presented during the past winter. Between October 4, 1884, and January 13, 1885, its motion appears to have increased in an alarming ratio. The spot continued to rush on far in advance of its computed places, and all the while exhibited a more brilliant appearance than at any preceding epoch since the autumn of 1880, when it first came under systematic observation. The form and appearance of the spot have been so special as to prevent any confusion in mistaking it for other white spots in nearly the same latitude. Between October 4 and January 13, 1885, the rotation period was 9h. 49m. 51·95s., but the great increase in velocity evidently occurred towards the end of November. Between November 21, 1884, and January 13, 1885, the period was only 9h. 49m. 38·45s., or 34 seconds less than the mean period of 9h. 50m. 12·25s. shown by the same spot during the two preceding years.

When the first intimation of this great increase of speed forced itself upon my notice, I at once resolved to obtain as many observations as possible, in order to assure myself more certainly of the fact. Much cloudy, wet weather ensued, but I observed the spot on fourteen occasions between November 27 and January 13. A lengthened period of overcast skies then supervened, and I saw nothing more of Jupiter until January 27, when the place of the spot, computed on the basis of my prior observations, appeared absolutely vacant. About 15° E. there was, however, a remarkably brilliant spot, the exact counterpart of the one previously observed. Then arose the question of identity. Could the velocity have become so much retarded in the fortnight's interval from January 13 to 27 as to have occasioned so considerable a displacement in longitude? From my observation on January 13 and several preceding nights the spot had shown an increasing disposition to slacken, and, from records obtained in previous years, the motion was known to fluctuate in the most unaccountable manner. In the seventeen days from September 30 to October 17, 1881, I noted the spot underwent a sudden translation of 11°·6 in the direction of east longitude. The fact w pendently confirmed by Prof. Hough at Chicago Stanley Williams at Brighton. The most ob partures from the mean rate of motion have been in other instances, and I am therefore led to that the objects observed on January 13 and were, notwithstanding their discordance of positi identical objects. The consistent brilliancy of the alluded to, for several months before the cloud set in, is entirely opposed to the idea that it co suddenly disappeared. And the real displaceme so large as the limiting observations suggest. a mean from my results near January 13 and 27, the following figures:—

| 1885 | Spot precedes on meridian (m.) |
|---|---|
| Jan. 7 to 13, mean of 7 obs. ... | 64·0 ... |
| Jan. 27 to Feb. 6, mean of 6 obs. ... | 40·4 ... |

Adopting this mean, we practically eliminate single observations, and in the present case it is f I obtained so many transits just before and period of cloud. The real displacement is seen f comparison to be only 10°·7, which is quite wit limits of previous experience. And if the fact of had not been rendered a very tenable hypothesis observation, I should have regarded the brilliant ance of the spot and its comparative isolation clusive. Moreover, during the period that this continued moving so rapidly, I often carefully ex the place where, had no change occurred, it mu been presented, but no object having a remo ness to the old spot could be detected. Having o this feature on the central meridian on more th nights, I am familiar with its usual aspect, and co possibly have overlooked it, on the many occasion I looked for it in vain, had the spot retained the a mate place assigned to it from the observations ceding years.

Let us now analyse the degree and period remarkable velocity alluded to. Arranging my o tions into short intervals, the following are the re periods severally derived from them:—

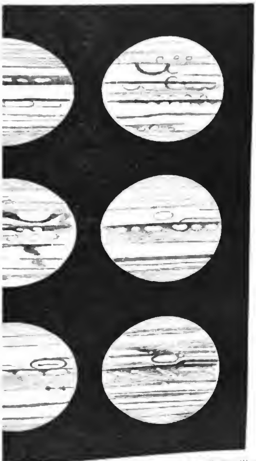
| 1884 | Interval in Minutes | Spot gained on ... Mer. (m.) | Spot gained in Long. | Number of Rotations | h |
|---|---|---|---|---|---|
| Oct. 4 to Nov. 7 | 48,965 | 6·5 | 6·0 | 83 | 9 |
| Nov. 7 to Nov. 20 | [illegible] | 3·3 | 2·1 | 30 | 9 |
| Nov. 21 to Nov. 27 | [illegible] | 16·1 | 9·0 | 15 | 9 |
| Nov. 27 to Dec. 9 | 17,258 | 17·4 | 10·0 | 29 | 9 |
| Dec. 9 to Dec. 18 | [illegible] | 13·6 | 8·3 | 22 | 9 |
| Dec. 18 to Dec. 24 | [illegible] | [illegible] | 5·6 | 13 | 9 |
| Dec. 24 to Dec. 31 | [illegible] | 9·5 | 5·8 | 17 | 9 |
| Dec. 31 to Jan. 8 | 14,[illegible] | 9·6 | 5·5 | 19 | 9 |
| 1885 | | | | | |
| Jan. 8 to Jan. 13 | [illegible] | 1·3 Lost | 2·0 Lost | 12 | 9 |
| Jan. 13 to Jan. 27 | [illegible] | 21·3 | 13·2 | 34 | 9 |
| Jan. 27 to April 19 | 118,[illegible] | 6·2 | 3·7 | 200 | 9 |

The period of really great acceleration extended forty days (November 21 to December 31), and remarkable that in the mean time the spot had com exactly one revolution of Jupiter relatively to the re In fact, the sudden increase and diminution of ve occurred with the white spot following the red 2h. 44m., so that there was a difference of 100° i longitude. The maximum speed appears to have shown between November 21 and 27, when the rota period was one minute less than the mean of the preceding years. But my observation of Novemb was considered rather late, and the interval being a short one of only six days, would originate a rather error. But the four short intervals, from November December 31, exhibit a singular consistency in th sulting periods, the mean being 9h. 49m. 36·16s., proves the real increase of speed to have been very

…e two preceding …r 27, we get a … accordant.

…nber 31, the spot … central meridian

(*Monthly Notices*, vol. xliv. No. 9), based on the period of 9h. 50m. 12·25s. The spot must therefore have moved 28,700 miles to the westward at the rate of 717 miles per terrestrial day, and 294 miles per Jovian day. Then after January 13 it suddenly retrograded if we accept the



[illegible]

…uary 13 and 27 [illegible] nearly 11,000 miles, previous excess. But … has steadied down …nd the period closely …Earth.

The motion of this brilliant white spot prior to January 13 is involved in no doubt whatever, so that the question of its identity with the one observed on January 27 is an entirely separate one, and cannot affect the remarkable phenomena, which the increased velocity exhibited, except as to the retrogressive motion which subsequently occurred. The question of identity may be definitely settled if any observations of the spot during the interval from January 13 to 27 are forthcoming from foreign observatories. In this part of England the sky was densely overcast at night during the whole of that time. If Prof. Hough at Chicago or some other systematic student of the planet can supply the missing links for the period referred to, it will be most important to ascertain how far they corroborate the assumed identity of the markings in question.

These white spots are liable to great variations in apparent brilliancy at short intervals; so that, unless an observer is very careful to discriminate between objects approximately situated, he is certain to introduce complications into his results. But, in regard to the conspicuous white spot which has been the subject of so much comment during the last few years, I have never found much difficulty in following it, because of its special character. Occasionally smaller spots slightly nearer the equator are seen on each side of it, but the leading spot of the trio is so bright and almost invariably shows a bright trail running from its north-east side towards the equator, that it may be readily identified. During the observations between October 4, 1884, and January 13, 1885, of the present opposition the extreme brilliancy of the spot was very noticeable, and the observations were pursued without any liability to error. I fear, however, that, morning observations being rendered necessary by the position of the planet in November and December will have enabled the singular vagaries of the white spot to have generally eluded notice.

It is curious that since the end of January this white spot has maintained a rate very nearly conformable to the first meridian of 9h. 50m. 12·25s., computed by Mr. Marth from the observations between 1882 and 1884; but there occurred a sudden deviation between March 14 and 18, amounting to some 8°. These singular displacements cannot be induced by changes in the form of the object, and they are far too considerable to be referred to errors of observation. Between February 9 and 16, 1882, Prof. Hough noticed an acceleration of 6$\frac{1}{2}$°.

The verification and true cause of these variations can only be efficiently sought out by frequent and very accurate observation. Our own climate is very ill-adapted to an investigation of this kind where the most essential point consists in closely consecutive results. What we need is an almost unbroken series. It is to be earnestly hoped that some attention will be devoted to this important work at the Lick Observatory, where "the elevation is 4200 feet above the sea, and *for six or seven months of the year every night is clear*." The position thus commands natural advantages in this work of far more importance than instrumental advantages, which would enable it to obtain some most valuable evidence bearing on the question of the remarkable variations affecting the white spots on Jupiter. Near the time of opposition they might be observed every night, and it is this consecutive, close treatment that is required before the phenomena will really admit of satisfactory discussion.

The question arises whether the whole southern belt partakes in these erratic and apparently frequent variations of speed, or whether they are confined to proper motions affecting the individual spots at different times. If several markings were made the subject of contemporary study it might soon be determined whether they exhibited uniform displacements, and, if so, it would have to be admitted that the whole equatorial atmospheric current is subject to the singular onrushes and alternating lulls which our recent observations have demonstrated.

Of the new features presented during the last few months the most striking are:—

(1) The appearance of large, bright spots indenting the north edge of the great northern equatorial belt. A peculiarity of these objects is that lines of light flowing from

their west sides divide the dark belt and
near the equator, where they became me
spots show a rotation period only a few se
the red spot.

(2) The outbreak of dark, reddish spots
longitude, upon the narrow belt which
in 1882, immediately outlying the great
pression north of the red spot was formed
this belt suddenly dipping northwards befo
spot where they became blended with the
spots now visible here are very plain and
increase until finally their material is dis
the planet and the belt becomes much dark
The individual spots should be carefull
ascertain whether this is their ultimate dev
rotation period they have hitherto shown i
same as that of the red spot. One of
spicuous of these new spots is about 10,000
follows the red spot 1h. 48m., so that its lo
east.

(3) The fading away of the west should
pression north of the red spot. This is now
and extends along the narrow belt far to th
red spot. It remains to be seen whether t
will continue now that various other regio
exhibit a confluent eruption of dark spots.

The several features referred to are of ext
as suggestive of peculiar forms of atmosp
ance and as affording fresh materials fo
Jovian phenomena. It will be necessary t
of these special features during the two eas
and to recover them, if still visible, when t
appears in the morning sky towards the en
next.

W. F.

## NOTES

At the *conversazione* of the Royal Society o
evening last week, the Fellows, we are sure, were
their President back again, in renewed health,
absence. Prof. Huxley had to welcome a very la
guests, and some of the objects exhibited were of g
Prof. H. N. Moseley exhibited a collection of F
pottery, charms, prayer-sticks, &c., from Zuni,
Gen. Strachey, an instrument for drawing curves of
in graphical representation of the harmonic c
periodical phenomena; Mr. W. T. Thiselton Dy
beautiful flowering specimens of Himalayan rhodo
small, rosy-pink *R. Maddeni* and the large, yel
*nuttallii*, a fruiting branch of coffee, and the variou
implements used in the collection and preparation o
rubber; iridio-platinum weights, with a density
absolutely adjusted, and a piece of platinum wire
inch, prepared by drawing, &c., were exhibited
Matthey; the Linnean Society lent a remarkable set
from the collection of Lady Impey, at Calcutta, p
native of Patna towards the end of the last century
perfect preservation; the Anthropological Institute
ethnographic photographs of various races, and
many highly interesting philosophical instruments

The Council of the British Association have app
J. Struthers, M.D., as a Vice-President of the As
the Aberdeen meeting, and have added the name
Stirling, M.D., D.Sc. (Aberdeen) to the list of those
for the Vice-Presidency of Section D.

At the invitation of Prof. Flower, a meeting of
Field Club will be held on Saturday afternoon, May
in the Lecture Room at the Zoological Gardens, whe
fessor will speak of the principal objects of inte

ty to visit them
most remarkable

ed in the *Izvestija*
vi.), in which he
n to Russia, and
publication of his
in two different
he reasons for any
undertaken, (*b*) a
each of them; the
cerning (*a*) anthro-
parative anatomy,
hopes to suit both
ome of his travels,
more particularly
the way it may be
e new species, viz.
) *Macropus Jukesii*,
*garagassi*, (7) *Mus*

e list of the papers
y of Sciences, April
U.S.A., methods of
H. Scudder, winged
ew; A. S. Packard,
of extinct malacu-
n undescribed family
acaridæ, a family of
acea, allied to the
efs of the Sandwich
ra of the Sandwich
of natural silicates;
movement of areas of
of the metre to the
tain stars observed by
; J. E. Hilgard and
of the approaches to
fishes; J. W. Powell,
l, on certain lunar in-
ed discovered by Mr.
Vertebrata of Brazil;
; C. A. Young, some
ed surface-markings of
the ohm; F. A. Genth
minerals—vanadinate,
lyrite, from the Sierra
; A. N. Skinner, by
of August 28, 1884;
volution and homologies
; Ira Remsen, chemical
Bell, the measurement
F. Della Torre, on the
and icebergs in a fog;
deceased members were
rard, U.S.A., by J. S.
U.S.A., by H. L. Abbot;
tall.

pleased to notice, as well
dary Commission. Mr.
in London, speaking of
stated to a press repre-
change of the tenancy of
country, and has made a

THE *Times* Calcutta Correspondent telegraphs that the Indian Government has at last begun to fulfil a promise made years ago to the Asiatic Society, that a systematic zoological exploration of the depths of the Indian seas should be undertaken, in connection with a survey of the coasts. "A skilled naturalist, Dr. Giles, has been attached to the surveying steamer *Investigator*, which is supplied with proper appliances for deep-sea dredging. During a recent cruise in the Bay of Bengal some casts were made with very interesting results. Some of the animals found appear to be new, and have been sent home for examination. The dredgings also proved that the depression of the bottom, near the mouth of the Hooghly, known as the Swatch, regarding which much speculation had been indulged in, was merely a deep submarine valley, forming part of the original basin of the Bay of Bengal—as Sir Charles Lyell long ago suggested."

A PORTION of the work of Protestant missionaries in China, which has attracted little attention in this country, and which, nevertheless, is of great importance, is the preparation of school and text-books in Chinese. For this purpose Protestant missionaries of all nationalities and denominations have united. At a general conference held in Shanghai in 1877, a committee of eight of the leading missionaries was appointed to superintend the preparation and publication of the series. The work has now been going on for eight years, and the Committee are able to report that over forty works have been issued, and that thirty more are in various stages of progress. In addition, four numbers have been issued of an "outline series" compiled with the object of supplying Chinese schools with small and simple treatises on scientific subjects at cheap rates, suitable either as elementary school books or as popular tracts for general distribution. What "cheap rates" mean will appear from the fact that the outlines of astronomy costs rather less than a penny, that of political and physical geography and geology about twopence each. The larger works embrace anatomy, in five volumes; ancient religions and philosophies in three; arithmetic, charts of astronomy, birds and mammals, with accompanying handbooks (these charts, from the prices, are obviously intended for the walls of schools); chemistry, political economy, geology, universal history, international law in translation of Bluntschli, in ... [illegible], zoology, and several on biblical topics. Those in preparation include treatises on various branches of elementary mathematics, botany, ethnology, hygiene, jurisprudence, logic, mathematical physics, meteorology, mineralogy, philology, and forty wall charts with accompanying handbooks. These works, it must be remembered, have first to be compiled with a special view to the knowledge usually possessed by Chinese children, and then to be translated, representing in each case two distinct tasks. That the missionaries in China and elsewhere have schools where they teach the young is well known, but it will probably be a surprise to many to find that, in addition to their ordinary labours as preachers and teachers, the missionaries in China have had to undertake a task of such magnitude as the creation of school literature on all subjects of human knowledge, from arithmetic to jurisprudence, and from anatomy to logic. The ... [illegible] on this subject is taken, it should be added, from the *Chinese Recorder* of Shanghai, a magazine which is itself a monument to the learning and enterprise of Protestant missionaries in China.

THERE will be an Exhibition of Plans, Maps, and Models in connection with the International Congress on Inland Navigation to be held in Brussels from May 24 to June 2. Those [illegible] desiring to contribute are requested to send in their exhibits at once, addressed, carriage free, to Mr. A. ... bert, 212, Rue du ... [illegible] Brussels.

AN interesting scheme in connection with the Bedford School is that of higher education for adults by means of evening lectures on literary and scientific subjects, at nominal fees. The lecturers are drawn for the most part from the staff of Bedford School. Among the scientific subjects included in the course are mathematics, geology, physical geography, and botany. Bedford is fortunate in having amongst its residents men qualified and willing to organise and carry out an excellent plan of this nature for its benefit.

The British Consul at Leghorn in his report for the past year makes some interesting observations on coral in the Mediterranean. Some centuries back the Mediterranean coral fisheries were carried on exclusively by the Spaniards, and the principal establishments engaged in the manufacture of coral ornaments were in the hands of Jews residing in Spain. Towards the close of the sixteenth century, to escape the persecutions to which they were exposed, a large number of these merchants removed to Leghorn, in order to enjoy the secure asylum afforded by the liberal enactments of Ferdinando di Medici. Crews were obtained from the Neapolitan coast, principally from Torre del Greco; hence this place at an early period became the chief seat of the coral fishery, and most of the boats engaged in it are still fitted out at that port, although the manufacture of coral ornaments and beads is carried on principally at Leghorn and Genoa. These ornaments are met with in almost every part of the world, and in many countries, even in Europe, coral is believed to be possessed of a peculiar charm. In Asia and Africa it is regarded with a sort of religious veneration, while in India it is largely used for the adornment of corpses when prepared for cremation. But the present situation of the coral trade is disastrous. In 1882, a coral bank several kilometres in length was discovered near the island of Sciacca, on the coast of Sicily, and consequently the yield of raw material has been far in excess of the demand, and the reef is still very far from being exhausted. A great depreciation in value has ensued, and as a consequence an extensive trade has sprung up in coral with Africa, where the natives now purchase coral ornaments in place of glass beads of Venetian and German manufacture. The raw coral comes from Naples, and is worked at Leghorn by women into beads, British India and Egypt being the chief customers for them.

On April 24 Mr. Edward Berdoe, M.R.C.S., read a paper at University College, Gower Street, before the Browning Society, on "Browning as a Scientific Poet." The paper, as reported in the *Lancet*, opened with an exhaustive argument to prove that the progress of science need not, as some had said, tend to the destruction of the poetic art; that, in fact, some of the greatest poets had enriched their verse by the study of natural phenomena—Lucretius, Haller, Milton, and Goethe, and in our own times Tennyson and Browning, while students of natural and physical science had not found their exact acquaintance with natural laws impede the luxuriant growth of their poetic fancy. Many of Browning's most beautiful similes were the result of his intimate acquaintance with anatomy, physiology, and chemistry; and the use he constantly makes of figures drawn from the science of optics has enabled him to illustrate his favourite optimism by much beautiful imagery. The poet of the future will be denied his former "power of dealing capriciously with facts," but this restraint, Mr. Berdoe argued, would not repress the poetic spirit. Mr. Berdoe, in conclusion, claimed for Mr. Browning that he is essentially the poet for the scientific man; abreast of the highest culture of his time, and in close touch with the great aims of science.

Herr Schweiger, writing from Widdin to the *Monatsschrift für den Orient*, refers to baldness amongst Orientals. In Europe the idea is general that baldness is the prerogative of scholars;

in the East, on the other hand, it is the common c-
of two races—the Spanish Jews and the Turks, wh-
system has never been overwrought by any devotio-
studies. In some measure to explain the origin of
reason we must commence at the cradles of the
living side by side. The indolence of Oriental wo-
known and is manifested in sins of omission rather th-
mission. The Oriental mother neglects the princip-
her offspring. During the first eight days of its ex-
the infant is sprinkled with a little tepid water once
some old woman, then wrapped in coloured rags
trouble of frequent changes, the head being wrapped
wadded cap tied under the chin. This process is repe-
the succeeding weeks once every two days, until fi-
become too toilsome even for this repetition, and is
altogether, through fear, it is said, that the child w-
cold from frequent washings. Superstition has adde-
to laziness, for the women believe that the head o-
should never be washed, as the scab produced by the
for the eyes. This dirt, mixed with the secretions
sebaceous and other glands, becomes the home of
animal and vegetable parasites, which prevent the de-
of hair and destroy that already grown. The open
might assist in destroying these parasites, is, howeve-
excluded by the custom which is imperative amo-
peoples of never, by day or night, or upon any occasio-
ever, taking off the head-covering. At night the fez i-
for a linen cap of similar shape. This perpetual cove-
ally retards the growth of the hair, and transmission
gation do their work. Herr Schweiger, who has li-
East for many years, first noticed chronic baldness a-
lower classes of the Turks, especially the so-called S-
Salonica.

The National Fish Culture Association's hatchery
Kensington is now gradually becoming depleted of
are being transmitted to public waters gratuitously,
fishery at Delaford belonging to the Association. The
and hatching season has been very prosperous and
there being but a very low minimum mortality among
produced.

The Aquarium at the International Inventions Exh-
assuming a more complete aspect, and has been an
feature with visitors from the first. An Aquarium Ha-
now in the press and will be shortly published by Mess-
and Sons, containing a natural history of the fish in
and a series of articles upon the culture of fish, the ma-
of aquaria, &c.

On April 22 a meteor was seen descending in a str-
from the zenith at Tegelsta railway station in Uste-
Sweden, and fall some distance off. On the station-ma-
ceeding to the spot he found a stone, about the size of
and brown in colour, which smelt strongly of phospho-
struck against a hard object. It was split into three pie-
being forwarded to a museum.

The *Calcutta Gazette* has published a resolution
Government directing the institution of an inquiry,
specially selected officer, into the castes and occupatio-
people of Bengal. The results of this inquiry should be
ethnographical value.

The exceptionally heavy rainfall at Bergen on Octo-
1884, when 74 mm. were registered for the twenty-fou-
was commented on at the time by the Scandinavian
affording confirmatory evidence of the truth of the

Norway. This
liefs, has been
entific observa-
ual mean of its
e other seventy
hile at Bergen
t Domsten and
73 mm. It has
tered at Holme-
ainfall at Bergen
in-measurements
ghteen instances
the rainfall has
these the most
t and Flesje, at
ay (December 8,
. were registered
These downfalls,
bservations were
to Dr. Hamberg
ernösand, where
cts such as these
ly maintained by
t Bergen both in
any other place in
eter of the annual
chances are about

e occurrence of a
November 14 last
humility that this
of Heaven for his
his staff. They will,
the lesson to heart
ill be remembered
se" as an important
h a large trade in
so worth notice as
t winter was mani-
have affected the
the shock lasted an
of houses, temples,
ost, and much injury

*lletin Scientifique* in
ink, on account of its
the study of certain
in keeping infusoria,
cubonic matter not
legree. For making
should be gradually
Many organisms which
are easily observed in
ecially the case with
s new method could
study of the digestion
iliated organisms.

y's Gardens during the
*(Cercopithecus callitrichus)*
); a Rhesus Monkey
ted by Miss Margaret
*gitulus*) from North-
; a Grey Ichneumon
ted by Mrs. Douglas ;
*icana*) from Bahamas.
Lizards (*Phrynosoma*

*cornutum*) from Texas, presented by Mr. J. G. Witte; a Dorsal Squirrel (*Sciurus hypopyrrhus*) from Central America, an Indian Mynah (*Acridotheres gingianus*), four White-backed Pigeons (*Columba leuconota*), a Black Hill-Squirrel (*Sciurus macrurus*) from India, two Chinese Jay-Thrushes (*Garrulax chinensis*) from China, a Sun Bittern (*Eurypyga helias*) from Brazil, two Greek Partridges (*Caccabis saxatilis*), South European, a Double-banded Sand-Grouse (*Pterocles bicinctus*) from Senegal, a Talapoin Monkey (*Cercopithecus talapoin*) from West Africa, a Negro Tamarin (*Midas ursulus*), a Humboldt's Lagothrix (*Lagothrix humboldti* ♂), a Rosy-billed Duck (*Metopiana peposaca* ♀) from South America, a Viscacha (*Lagostomus trichodactylus*), a Scorpion Mud-Terrapin (*Cinosternum scorpioides*) from Buenos Ayres, a Gadwell (*Chaulelasmus streperus* ♂), nine Spotted Salamanders (*Salamandra maculosa*), European, purchased; a Crossoptilon (*Crossoptilon manchuricum* ♂) from Northern China, received in exchange; a Gayal (*Bibos frontalis*), two Long-fronted Gerbilles (*Gerbillus longifrons*), born in the Gardens.

## OUR ASTRONOMICAL COLUMN

THE HARVARD COLLEGE OBSERVATORY, U.S.—The thirty-ninth Annual Report of this Institution has been issued, and with it Prof. Pickering's summary of observations of variable stars in 1884, made agreeably to the plan suggested by him in a communication to the American Academy of Arts and Sciences (vol. xix. p. 296). Thirteen observers, private and professional, have co-operated in these observations, amongst them Mr. Knott, of Cuckfield, and Mr. T. W. Backhouse, of Sunderland. In the summary referred to, the positions of the stars for 1875, the limits of variation and the periods, as far as reliably determined, are repeated from the circular of last year, and these particulars are followed by a statement of the number of observations of each star, made by the various observers in the course of 1884, so that it is easy to see which objects most require attention. It is certain that in this branch of observational astronomy there is ample work for a much larger number of co-operators, which it may be hoped that Prof. Pickering will succeed in enlisting amongst our amateurs, and eventually it may be possible to particularise the objects which each one may undertake to watch effectively, so as to secure observations of the whole or the majority of the list in each year.

With regard to the general proceedings of the Harvard Observatory, it is stated that photometric observations of the eclipses of Jupiter's satellites have been continued upon the system adopted in 1878, and 254 eclipses have now been thus observed, forty-seven since the end of October, 1883. The revision of the zone-observations of stars between 50° and 60° north of the equator has been completed during the year. Selections of stars for standards of stellar magnitude have been made for regions extending four minutes (time) in right ascension, and ten minutes in declination, and additional photometric methods of measurement are under consideration for determining such magnitudes with satisfactory precision. Observations of comets, of the spectra and colours of stars, and a tentative revision of the magnitudes of the *Durchmusterung*, have also formed a part of the year's work. We do not learn from the report that any attempt has been made to repeat the valuable series of observations on the rings of Saturn made by the Bonds, &c., with the Harvard 15-inch refractor, when the planet was previously situated in the position it occupied in 1884, but the class of observations more especially attended to at present may have rendered this impracticable. Vol. xiv. parts 1 and 2 of the *Annals* have been published; the latter part has been circulated very recently.

TEMPEL'S COMET (1867 II.).—Up to the 7th inst. it does not appear that the editor of the *Astronomische Nachrichten* had received any notice of the re-observation of this comet. [illegible] it could only have been of the last degree of faintness, commanded last month by instruments of the highest order. In the next period of absence of moonlight the theoretical brightness will have diminished. The comet will be due in perihelion again in the spring of 1892, a more favourable condition for the observation of this body than has existed in the present [illegible] year.

NEW NEBULÆ.—M. Stephan publishes positions and descriptions of 100 nebulæ discovered at Marseilles in the years 1883-85, in addition to the large number previously detected at that observatory. Not the least notable characteristic of M. Stephan's catalogues is the precision of the places given in them. He mentions that on October 1 and 2, 1882, neither the nebula Dreyer-Schultz 5085 nor *h* 12 were perceptible in the positions assigned to them by the discoverers.

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, MAY 17-23

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on May 17*

Sun rises, 4h. 7m.; souths, 11h. 56m. 10·8s.; sets, 19h. 46m.; decl. on meridian, 19° 36′ N.: Sidereal Time at Sunset, 11h. 29m.

Moon (at First Quarter May 21, 6h.) rises, 6h. 59m.; souths, 14h. 53m.; sets, 22h. 44m.; decl. on meridian, 18° 7′ N.

| Planet | Rises h. m. | Souths h. m. | Sets h. m. | Decl. on meridian ° ′ |
|---|---|---|---|---|
| Mercury | 3 37 | 10 37 | 17 23 | 9 41 N. |
| Venus | 4 18 | 12 10 | 20 3 | 19 55 N. |
| Mars | 3 24 | 10 36 | 17 48 | 13 13 N. |
| Jupiter | 11 0 | 18 15 | 1 30* | 13 38 N. |
| Saturn | 5 43 | 13 51 | 21 59 | 22 18 N. |

* Indicates that the setting is that of the following day.

*Occultations of Stars by the Moon*

| May | Star | Mag. | Disap. h. m. | Reap. h. m. | Corresponding angles from vertex to right for inverted image ° ° |
|---|---|---|---|---|---|
| 19 | α Cancri | 4 | 22 52 | 23 15 | 48 359 |
| 21 | B.A.C. 3407 | 6 | 0 21 | 1 12† | 125 276 |
| 21 | 35 Sextantis | 6 | 20 46 | 21 18 | 26 340 |

† In below horizon at Greenwich.

*Phenomena of Jupiter's Satellites*

| May | h. m. | | May | h. m. | |
|---|---|---|---|---|---|
| 17 | 23 21 | II. occ. disap. | 21 | 0 21 | I. occ. disap. |
| 19 | 20 28 | II. tr. egr. | | 21 41 | I. tr. ing. |
| 20 | 21 33 | III. occ. reap. | 22 | 0 1 | I. tr. egr. |
| | 23 10 | III. ecl. disap. | | 22 22 | I. ecl. reap. |

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

May 21, 3h.—Jupiter in conjunction with and 4° 15′ north of the Moon.

## THE IRON AND STEEL INSTITUTE

THE Iron and Steel Institute met on Wednesday, the 7th inst., when Dr. Percy gave the presidential address. After inviting the co-operation of the members in supplying him with materials for the new edition of his work on "Iron and Steel," and referring to Mr. Lowthian Bell's recent valuable work on the same subject, Dr. Percy drew attention to the existing universal depression, due, in his opinion, to over-production. "Darwinianism prevails in the manufacturing world as it does in the natural world, however painful and unwelcome may be that truth—only the fittest will survive. The struggle may be severe and to many persons disastrous, but so long as supply exceeds demand, it is inevitable, and the result is not doubtful."

In the matter of technical education he regretted that a few of its professed friends should have indiscreetly attempted to imbue all our artisans with the notion that the one thing which at present they urgently need is technical education, and that it will be certain to benefit them all alike, whereas in some trades, such as that of the file-cutter, the marvellous skill which is alike the surprise and admiration of all is to be obtained only by the practice of his art. He referred with pleasure to the judicious and enlightened way in which Sir Bernhard Samuelson, M.P., had advocated technical education in its widest sense, and rejoiced over the liberality of the founders of the Owens College (now the Victoria University) in Manchester, the Mason College in Birmingham, and the Firth College in Sheffield, and of the Whitworth Scholarships, through whose aid scientific instruction is placed within the reach of the artisan class.

The major portion of the address was devoted to the and chemical properties of iron and steel, and the President's remarks brought out in strong relief the p[...] want of knowledge. How comes it, he inquires, that [...] of cohesion should be increased by mechanical treatment [...] *à froid*, might be supposed would tend in greater or les[...] to produce disaggregation? Why is iron or steel wire in[...] in strength by wire-drawing? What is the cause of the [...] changes which some metals and alloys have been obse[...] undergo spontaneously while at rest and under ordinar[...] spheric conditions?

"It is not many years since that we had to grope a[...] discover an analysis of iron ore or of pig iron, whereas [...] are actually overwhelmed with such analyses. We are [...] with percentages of carbon, graphitic or combined, of [...] and manganese, of sulphur and phosphorus. We are bew[...] by this vast accumulation of material. What is now wa[...] the man to reduce it to law and order, to evolve [...] principles for our sure guidance. But the problem is so [...] and complex that no common brain can solve it. What [...] physical properties of pure iron after fusion? What a[...] chemical and physical properties of compounds of pure ir[...] pure silicon in various proportions? What are the mo[...] existence of manganese, silicon, and phosphorus when [...] together in pig iron? What is the *modus operandi* of [...] ganese in the manufacture of iron and steel? Why are [...] matters or certain other substances rich in nitrogen, requi[...] case-hardening iron? Is any nitrogen or any compound [...] imparted to the case-hardened part of the iron? The[...] such like questions the metallurgist asks of the natural [...] sopher and chemist, and has failed hitherto to receive a rep[...]

Having concluded what may be called the technical p[...] his address, Dr. Percy treated the question of the exte[...] which the Government of a country should engage in [...] facture, and stated "that, if it could be shown that the peo[...] a whole would be benefited by the Government's engag[...] manufacture, then the Government was bound to take [...] course." Treating the various cases of armour-plates, ste[...] guns, and steel for ship-plates, he showed that in each [...] owing to competition, co-operative management, and [...] causes, private industry was always able to produce artic[...] good as and cheaper than the Government.

The address was listened to with the greatest atte[...] throughout, both on account of the inherent interest o[...] matter and the great oratorical skill employed in its deli[...] The closing paragraphs are of such universal interest tha[...] quote them verbatim:—

"Everything in this world, nay, there is reason to bel[...] everything in the universe itself, is changing from momen[...] moment. There is, as I have stated in print long ago, not[...] constant but change, however paradoxical that statement [...] appear. Every drop of rain that falls, for instance, exer[...] levelling action on the hills and mountains, and carries d[...] with it in its course to the ocean a minute yet sensible por[...] of earthy material. In the moral world the like incess[...] change is going on, and no one can predict what the final re[...] of that change will be. Our globe may, it seems to me, be [...] compared with the laboratory of the philosopher. The one, [...] our finite understandings, may appear the scene of social [...] political experiments, just as the other is the scene of chemi[...] and physical experiments. But of this we may be sure, that [...] variable and irresistible law guides all things, immaterial as w[...] as material. When I reflect on the intricate social problems [...] the day, the solution of which excites dread in the minds [...] many, I fancy I see the social molecules, if I may use such [...] expression, actively at work in rearranging and adjusting the[...] selves to new conditions, and producing results as surprising [...] they are remarkable. The mysterious forces, whatever th[...] may be, which regulate the movements of these molecules, a[...] as certain in their operation as those which determine the cour[...] of the planets in their orbits. Both are equally uncontrollabl[...] by the agency of man, and politicians will in vain strugg[...] against them.

"There is a question that must often occur to us, namely what will Great Britain be when our vast reservoir of materia[...] force, coal, is exhausted—a result which many members of th[...] Iron and Steel Institute are doing their utmost to accelerate[...] The time must come when, in consequence of that exhaustion, Great Britain will cease to be a great manufacturing nation, unle[...] some new source of force should be discovered, which there is

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pound of iron and carbon, which has a pearly structure; one of these is like the main constituent of such bar iron as contains little or no carbon, having no trace of linear marking, after being acted upon by dilute acid, whereas the other constituent shows linear markings, varying in distance, but often about 1-20,000th of an inch apart, which, when the acid has acted to a proper extent, gives rise to all the splendid colours of mother-of-pearl, the tints being raised when the section is seen in water, and still more so when mounted in balsam. By oblique and direct illumination the colours are nearly complementary. Swedish iron partly converted into blister steel by cementation, shows a mixture of well-formed crystals of free iron and of the pearly compound in the centre; around this a ring of the pearly compound, with colours of great variety and beauty; whilst on the outside is a part in which occurs a network of veins of an extremely hard substance, giving an intensely brilliant reflection and no trace of colour, which seems to contain more carbon than the pearly constituent. The three constituents just described are totally distinct from one another. There is no more passage from one to the other than there is between the mica, felspar, and quartz of granite.

The varying character of ingots of soft and hard steel to a great extent depends on the varying proportion of the three principal constituents. Soft Bessemer steel is seen to be a mixture of free iron and the pearly compound. In medium steel this latter occurs almost alone, whereas in hard steel there is little, if any, free iron, but numerous thin plates of the very hard compound. Besides these three constituents in steel, the microscope gives evidence in cast-iron of the presence of graphite and silicon. The specimen of spiegeleisen studied, consisted mainly of the intensely hard compound, crystallised in large plates, the inter-spaces being filled up with a mixture of very much smaller crystals with a little of the pearly substance, so as to have a most beautiful and fine-grained structure. Taken, then, as a whole, the various kinds of iron and steel are seen to be varying mixtures of three or four out of six or seven substances having very different properties, viz. free iron, the pearly compound with carbon, the intensely hard compounds, probably with more carbon; the residual, probably variable, substance; graphite; possibly crystallised silicon; slag, including fused iron oxide.

On the second day the attention of the meeting was occupied with the subject of the coking of coal by different processes and the recovery of bye-products. Mr. Head's paper contained a description of a modified form of the Siemens old type gas-producer, in which the latter result is effected by dividing the gas-producer by means of a vertical wall into two compartments, one of which receives the hydrocarbons—the volatile constituents of the coal—and the other the carbonic oxide formed by the decomposition of the solid carbonaceous matter. Two other papers referred to results obtained in connection with the Simon-Carvé's coking process. Prof. Armstrong's note with reference to the method's purpose of coking coal and recovering volatile matter has much scientific interest, and we propose to refer to it shortly. The problem consists in as complete a recovery as possible of the matters latent in coal, in the most economical manner and advantageous forms, the treatment depending upon the [illegible] of coal and [illegible]. The author considers the compounds in coal to be mainly of two kinds—phenolic compounds, which are the primary source of the phenols (carbolic acid, &c.) contained in coal tar, and paraffinoid compounds, capable of yielding hydrocarbons such as are obtained on distilling shale, the high temperature tar, such as is obtained at gas-works, not being primary but secondary products of [illegible], may be considered final products, the quality of which it will be impossible to improve, whereas the object should be to produce [illegible] low temperature tars which by after-treatment might be made to produce a large proportion of benzene and other valuable products.

The author's idea of a theoretically perfect coking oven is one [illegible] like the [illegible] kettle, with the upper flat [illegible] should be exposed upon the surface of the [illegible] coked, thus forming a charge of coal, which [illegible] coked, thus forming a [illegible] layer, below which distillation would take place, the products of distillation being sucked away as rapidly as possible [illegible] the oven. The products of combustion [illegible] would carry no oxygen with them [illegible] of the large volume of steam [illegible] within the mass, and of the low temperature, the ammonia would probably almost entirely escape destruction. The gas would be of low illuminating quality, but would be available for carbonising, oil and ammonia being removed from it by efficient scrubbing. The author was of opinion that nothing was known practically of what happens when coal is distilled, and that the coking of coals and manufacture of gas were now only empirical operations, and could not be conducted scientifically, with our present imperfect knowledge, but that the interests involved were so great, the subject being one of national importance, that failure to initiate and execute the necessary systematic experiments without further loss of time would be inexcusable.

On the last day of the meeting Mr. Carnegie's paper on "Natural Gas Fuel and its Application to Manufacturing Purposes" was read. This fuel is found in the Pittsburg district, and one of the wells is estimated as yielding 30,000,000 cubic feet of gas in the twenty-four hours; the pressure of the gas as it issues from the mouth of the well is about 200 lbs. to the square inch, and even at the works, nine miles from the wells, it is 75 lbs. per square inch. Eleven lines of pipe convey the gas from the various wells to the manufacturing establishments in and around Pittsburg. The number of men whose labour will be dispensed with when gas is generally used is 5000. In the steel-rail mills, for instance, where before would have been seen thirty stokers, stripped to the waist, firing boilers which require a supply of about 400 tons of coal in twenty-four hours—ninety firemen in all being employed, each working eight hours—there would now be found one man walking around the boiler-house, simply watching the water-gauges, and not a particle of smoke is to be seen.

Dr. Hermann Wedding's paper on "The Properties of Malleable Iron deduced from its Microscopic Structure" draws attention to the value of microscopic analysis, as, though the chemical and physical properties of iron are closely connected, the one cannot be directly deduced from a knowledge of the other, nor do either of these aid in acquiring a knowledge of the mechanical properties. The pieces of iron to be tested are carefully polished, and then etched with very dilute nitric acid. After etching, the section is carefully heated, whereupon the portions attacked acquire varying tints, mostly golden-yellow, purple-red, violet, or dark blue. It is the difference of colour that is characteristic. As regards the formation of grains and fibres, the size of grain increases with slowness of cooling, and decreases with increase in the proportion of carbon up to 2 per cent. Each individual grain in malleable iron is ductile, the malleability of the entire piece depending on that of the separate grains, which are drawn out into fibres; the strength of fibrous iron depending on the fact that, like the individual hemp-fibres in a rope, the fibres lie with their ends in various sections. The microscope shows, further, that none of these wires or fibres is directly connected with its neighbours, either in a longitudinal or lateral direction. In fact each fibre may, by careful etching, be picked out like those of a muscle in the human body. The paper treats also of the constitution of individual iron crystals and of welding. The general result of the analysis shows that the strength of a finished piece of iron depends on the sectional area of the mass of iron it contains, the slag inclusions in weld-iron and blow-holes in ingot-iron being deducted.

It was announced that the autumn meeting of the Institute would be held at Glasgow.

## *SUNLIGHT AND THE EARTH'S ATMOSPHERE*[1]

### II.

WE have been compared to creatures living at the bottom of the sea who frame their deceptive traditional notions of what the sun is like from the feeble changed rays which sift down to them. Though such creatures could not rise to the surface, they might swim up towards it, and if these rays grew hotter, brighter, and bluer as they ascended, it would be almost within the capacity of a fish's mind to guess that they are still brighter and bluer at the top.

Since we children of the earth, while dwelling on it, are always at the bottom of a sea, though of another sort, the most direct method of proof I spoke of, is merely to goup as far as we can and observe what happens, though as we are men, and not fishes, something more may fairly be expected of our intelligence than of theirs.

We will not only guess, but measure and reason, and in particular we will first, while still at the bottom of the mountain, draw the light and heat out into a spectrum, and analyse every part of it by some method that will enable us to explore the invisible as well as record the visible. Then we will ascend many miles into the air, meeting the rays on the way down, before the sifting process has done its whole work, and then analyse the light all over again, so as to be able to learn the different proportions in which the different rays have been absorbed, and, by studying the action on each separate ray, to prove the state of things which must have existed before this sifting—this selective absorption—began.

It may seem at first that we cannot ascend far enough to do much good, since the surface of our aërial ocean is hundreds of miles overhead; but we must remember that the air grows thinner as we ascend, the lower atmosphere being so much denser, that about one-half the whole substance or mass of it lies within the first four miles, which is a less height than the tops of some mountains. Every high mountain, however, will not do, for ours must not only be very high, but very steep, so that the station we choose at the bottom may be almost under the station we are afterwards to occupy at the top.

Besides we are not going to climb a lofty lonely summit like tourists to spend an hour, but to spend weeks; so that we must have fire and shelter, and above all we must have dry air to get clear skies. First I thought of the Peak of Teneriffe, but afterwards some point in the territories of the United States seemed preferable, particularly as the Government offered to give the Expedition, through the Signal Service, and under the direction of its head, General Hazen, material help in transportation and a military escort, if needed, any where in its own dominions. No summit in the eastern part of the United States rises much over 7000 feet, and though the great Rocky Mountains reach double this, their tops are the home of fog and mist, so that the desired conditions, if met at all, could only be found on the other side of the Continent in Southern California, where the summits of the Sierra Nevadas rise precipitously out of the dry air of the great wastes in lonely peaks, which look eastward down from a height of nearly 15,000 feet upon the desert lands.

This remote region was, at the time I speak of, almost unexplored, and its highest peak, Mount Whitney, had been but once or twice ascended, but was represented to be all we desired could we once climb it. As there was great doubt whether our apparatus, weighing several thousand pounds, could possibly be taken to the top, and we had to travel 3000 miles even to get where the chief difficulties would begin, and make a desert journey of 150 miles after leaving the cars, it may be asked why we committed ourselves to such an immense journey to face such unknown risks of failure. The answer must be that mountains of easy ascent and 15,000 feet high are not to be found at our doors, and that these risks were involved in the nature of our novel experiment, so that we started out from no love of mere adventure, but from necessity, much into the unknown. The liberality of a citizen of Pittsburgh, to whose encouragement the enterprise was due, had furnished the costly and delicate apparatus for the expedition, and that of the trans-continental railroads, enabled us to take this precious freight along in a private car, which carried a kitchen, a steward, a cook, and an ample larder besides.

In this we crossed the entire continent from ocean to ocean, stopped at San Francisco for the military escort, went 300 miles south so as to get below the mountains, and then turned eastward again on to the desert, with the Sierras to the north of us, after a journey which would have been unalloyed pleasure except for the anticipation of what was coming as soon as we left our car. I do not indeed know that one feels the triumphs of civilisation over the opposing forces of Nature anywhere more than by the sharp contrasts which the marvellous luxury of recent railroad accommodation gives to the [illegible] desert. When one is in the centre of one of th[illegible] [illegible]ps of the globe, and, after looking out f[illegible] the flying train on its scorched wastes for [illegible] lation, turns to his well-furnishe[illegible] ices of his desert, he need no[illegible] story who we[illegible] carried across drea[illegible] on the b[illegible]w genii. Ours t[illegible] to th[illegible] It was growing the[illegible] midst of vast [illegible] m[illegible] sleep, we step[illegible] sa[illegible] roll away in[illegible] ric[illegible] ditions of c[illegible] aln. [illegible] would well be[illegible]

[1] Lecture delivered at the Royal Institution, April 17, 1885, by S. P. Langley. Communicated by the author. Continued from p. 20.

commenced our slow toil northward with a thermometer at 110° in the shade, if any shade there be in the shadeless desert, which seemed to be chiefly inhabited by rattlesnakes of an ashen gray colour, and a peculiarly venomous bite. There is no water save at the rarest intervals, and the soil at a distance seems as though strewed with sheets of salt, which aids the delusive show of the mirage. These are, in fact, the ancient beds of dried-up salt lakes or dead seas, some of them being below the level of the ocean; and such a one on our right, though only about twenty miles wide, has earned the name of "Death Valley," from the number of human beings who have perished in it. Formerly an emigrant train, when emigrants crossed the Continent in caravans, had passed through the great Arizona deserts in safety until after their half-year's journey, their eyes were gladdened by the snowy peaks of the Sierras looking delusively near. The goal of their long toil seemed before them; only this one more valley lay between, and into this they descended, thinking to cross it in a day—but they never crossed it. Afterwards the long line of wagons was found with the skeletons of the animals in the harness, and by them those of men, women, and little children dead of thirst, and some relics of the tragedy remained at the time of our journey. I cite this as an indirect evidence of the phenomenal dryness of the region—a dryness which, so far, served our object, which was, in part, to get rid as much as possible of that water-vapour which is so well known to be a powerful absorber of the solar heat.

Everything has an end, and so had that journey, which finally brought us to the goal of our long travel, at the foot of the highest peak of the Sierras, Mount Whitney, which rose above us in tremendous precipices, that looked hopelessly insurmountable and wonderfully near. The whole savage mountain region in its slow rises from the west, and its descent to the desert plains in the east, is more like the chain called the Apennines, in the moon, than anything I know on the earth. The summits are jagged peaks like Alpine "needles," looking in the thin air so delusively near, that, coming on such a scene unprepared, one would almost say they were large grey stones a few fields off, with an occasional little white patch on the top, that might be a handkerchief or a sheet of paper dropped there. But the telescope showed that the seeming stones were of the height of many Snowdons piled on one another, and the white patches occasional snow-fields, looking how invitingly cool, from the torrid heat of the desert, where we were encamped by a little rivulet that ran down from some unseen ice-lake in that upper air. Here we pitched our tents and fell to work (for you remember we must have two stations, a low and a high one, to compare the results), and here we laboured three weeks in almost intolerable heat, the instruments having to be constantly swept clear of the red desert dust which the hot wind brought. Close by these tents a thermometer covered by a single sheet of glass, and surrounded by wool, rose to 237° in the sun, and sometimes in the tent, which was darkened for the study of separate rays, the heat was absolutely beyond human endurance. Finally, our apparatus was taken apart and packed in small pieces on the backs of mules, who were to carry it by a ten days' journey through the mountains to the other side of the rocky wall which, though only ten or twelve miles distant, arose miles above our heads; and, leaving these mule trains to go with the escort by this longer route, I started with a guide by a nearer way to those white gleams in the upper skies, that had daily tantalised us below in the desert with suggestions of delicious, unattainable cold. That desert sun had tanned our faces to a leather-like brown, and the change to the cooler air as we ascended was at first delightful. At an altitude of 5000 feet we came to a wretched band of nearly naked savages, crouched around their camp-fire, and at 6000 found the first scattered trees; and here the feeble suggestion of a path stopped, and we descended a ravine to the bed of a mountain stream, up which we forced our way, cutting through the fallen trees with an axe, fighting for every foot of advance, and finally passing what seemed impassable. It was interesting to speculate as to the fate of our [illegible] and other precious freight, now somewhere [illegible] quite useless. We were committed now, [illegible] of it—and, besides, I had begun to [illegible] a more personal subject. This [illegible] more the sun burnt the skin— [illegible] that by the end of the third [illegible], as I thought, in the [illegible] seared with red hot [illegible] ter had fallen to [illegible] paradoxical effect increased: the colder it grew about us, the hotter the sun blazed above.

We have all heard probably of this curious effect of burning in the midst of cold, and some of us may have experienced it in the Alps, where it may be aided by reflection from the snow, which we did not have about us at any time except in scattered patches, but here by the end of the fourth day my face was scarcely recognisable, and it almost seemed as though sunbeams up here were different things, and contained something which the air filters out before they reach us in our customary abodes. Radiation here is increased by the absence of water vapour too, and on the whole this intimate personal experience fell in almost too well with our anticipations that the air is an even more elaborate trap to catch the sunbeams than had been surmised, and that this effect of selective absorption and radiation was intimately connected with that change of the primal energies and primal colour of the sun which we had climbed towards it to study.

On the fourth day, after break-neck ascents and descents, we finally ascended by a ravine, down which leaped a cataract, till, at nightfall, we reached our upper camp, which was pitched by a little lake, one of the sources of the water-fall, at a height of about 12,000 feet, but where we seemed in the bottom of a valley, nearly surrounded as we were by an amphitheatre of rocky walls which rose perpendicularly to the height of Gibraltar from the sea, and cut off all view of the desert below or even of the peak above us.

The air was wonderfully clear, so that the sun set in a yellow rather than an orange sky, which was reflected in the little ice-rimmed lakes and from occasional snow-fields on the distant waste of lonely mountain summits on the west.

The mule train sent off before by another route, had not arrived when we got to the mountain camp, and we realised that we were far from the appliances of civilisation by our inability to learn about our chief apparatus, for here, without post or telegraph, we were as completely cut off from all knowledge of what might be going on with it in the next mountain ravine as a ship at sea is of the fate of a vessel that sailed before from the same port. During the enforced idleness we ascended the peak nearly 3000 feet above us, with our lighter apparatus, leaving the question of the ultimate use of the heavy ones to be settled later. There seemed little prospect of carrying it up, as we climbed where the granite walls had been split by the earthquakes, letting a stream of great rocks, like a stone river, flow down through the interstices by which we ascended, and, in fact, the heavier apparatus was not carried above the mountain camp.

The view from the very summit was over numberless peaks on the west to an horizon fifty miles away, of unknown mountain-tops, for, with the exception of the vast ridge of Mount Tyndall, and one or two less conspicuous ones, these summits are not known to fame, and, wonderful as the view may be, all the charm of association with human interest which we find in the mountain landscape of older lands is here lacking.

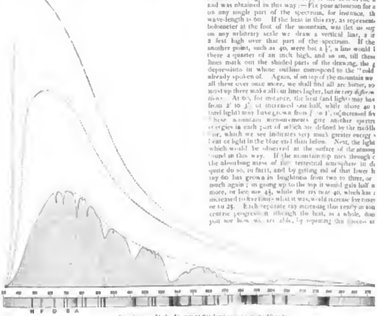
It was impossible not to be impressed with the savage solitude of this desert of the upper air, and our remoteness from man and his works, but I turned to the study of the special things connected with my mission. Down far below the air seemed filled with reddish dust that looked like an ocean. This dust is really present everywhere (I have found it in the clear air of Etna), and though we do not realise its presence in looking up through it, to one who looks down on it, the dwellers on the earth seem indeed like creatures at the bottom of a troubled ocean. We had certainly risen towards the surface, for about us the air was of exquisite purity, and above us the sky was of such a deep violet blue, as I have never seen in Egypt or Sicily, and yet even this was not absolutely pure, for separately invisible, the existence of fine particles could yet be inferred from their action on the light near the sun's edge, so that even here we had not got absolutely above that dust shell which seems to encircle our whole planet. But we certainly felt ourselves not only in an upper, but a different region. We were on the ridge of the continent, and the winds which tore by had little in common with the air below, and were beating past us (according to the geologists) dust which had once formed part of the soil of China, and been carried across the Pacific Ocean; for here we were lifted into the great encircling currents of the globe, and, "near to the sun in lonely lands," were in the right conditions to study the differences between his rays at the surface and at the bottom of that turbid sea where we had left the rest of mankind. We descended the peak and hailed with joy the first arrival of our mule trains with the requisite apparatus at the mountain camp, and found that it had suffered less than might be expected, considering the pathless character of the wilderness. We went to work to build piers and mount telescopes and sidereostats, in the scene shown by the next illustration on the screen, taken from a sketch of my own, where these rocks in the immediate foreground rise to thrice the height of St. Paul's. We suffered from cold (the ice forming 3 inches deep in the tents at night) and from mountain sickness, but we were too busy to pay much attention to bodily comfort, and worked with desperate energy to utilise the remaining autumn days, which were all too short.

Here, as below, the sunlight entered a darkened tent, and was spread into a spectrum, which was explored throughout by the bolometer, measuring, on the same separate rays which we had studied below in the desert, all of which were different up here, all having grown stronger, but in very different propor-

tions. On the screen is the spectrum as seen in drawn on a conventional scale, neither prismatic n but such that the intensity of the energy shall be t each part, as it is represented here by these equal perp in every colour. Fix your attention on these three as you will see better what we found on the mountain, we inferred as to the state of things still higher up, at of the aerial sea.

You will obtain, perhaps, a clearer idea, however, following statement, where I use, not the exact figure calculation, but round numbers, to illustrate the pe ployed. I may premise that the visible spectrum ext H (in the extreme blue) to A (in the deepest red), or 40 (the ray of forty one hundredth thousandths of a mil wave-length) to near 80. All below 80, to the rig invisible infra-red spectrum.

Now, the shaded curve above the spectrum repre amount of energy in the sun's rays at the foot of the m and was obtained in this way:—Fix your attention for a on any single part of the spectrum, for instance, th wave-length is 60. If the heat in this ray, as represente bolometer at the foot of the mountain, was (let us say on any arbitrary scale we draw a vertical line, 2 in 2 feet high over that part of the spectrum. If the another point, such as 40, were but a ¼", a line would b there a quarter of an inch high, and so on, till these lines mark out the shaded parts of the drawing, the g depressions in whose outline correspond to the "cold already spoken of. Again, if on top of the mountain we all these over once more, we shall find all are hotter, so must up there make all our lines higher, but *in very differen tions*. At 60, for instance, the heat (and light) may hav from 2' to 3', or increased one half, while above 40 t (and light) may have grown from ¼' to 1', or increased fo These mountain measurements give another spectru energies in each part of which are defined by the middle line, which we see indicates very much greater energy heat or light in the blue end than below. Next, the light which would be observed at the surface of the atmosp found in this way. If the mountain-top rises through c the absorbing mass of the terrestrial atmosphere in de quite do so, in fact), and by getting rid of that lower h ray 60 has grown in brightness from two to three, or much again; in going up to the top it would gain half m more, or become 4½, while the ray near 40, which has increased to five times what it was, would increase five times or to 25. Each separate ray increasing thus nearly in geo metric progression through the heat, as a whole, doe you see how we are able, by repeating this process at




Distribution of Solar Energy at Sea-level ...

point, to build up our outer or highest curve, which represents the light and heat at the surface of the atmosphere. These have grown out of all proportion at the blue end, as you see by the outer dotted curve, and now we have attained, by actual measurement, that evidence which we sought, and by thus reproducing the spectrum outside the atmosphere, and then recombining the colours by like methods to those you have seen on the screen, we finally get the true colour of the sun, which tends, broadly speaking, to blue.

It is so seldom that the physical investigator meets any novel fact quite unawares, or finds anything except that in the field where he is seeking, that he must count it an unusual experience to come unexpectedly on even the smallest discovery. This experience I had on one of the last days of work on the spectrum on the mountain. I was engaged in exploring that great invisible heat region, still but so partially known, or, rather, I was mapping in that great "dark continent" of the spectrum,

and by the aid of the exquisitely sensitive instrument (bolometer) found I could carry the survey farther than any been before. I substituted the prism for the grating, and c sured on in that unknown region till I had passed the Ul Thule of previous travellers, and finally came to what see the very end of the invisible heat spectrum beyond what previously been known. This was in itself a return for m trouble, and I was about rising from my task when it occu to me to advance the bolometer still farther, and I shall not fo the surprise and emotion with which I found new and yet recognised regions below, a new invisible spectrum beyond farthest limits of the old one.

I will anticipate here by saying that after we got down lower earth again the explorations and mapping of this r region was continued. The amount of solar energy included this new extension of the invisible region is much less than t of the visible spectrum, while its length upon the wave-len scale is equal to all that previously known, visible and invisible, as you will see better by this view, saving the same thing on the normal as well as the prismatic scale. If it be asked which of these is correct, the answer is "both of them." Both rightly interpreted mean just the same thing, but in the lower one we can more conveniently compare the ground of the researches of others with these. These great gaps I was at first in doubt about, but more recent researches at Alleghany make it probable that they are caused by absorption in our own atmosphere, and not in that of the sun.

We would gladly have stayed longer, in spite of physical discomfort, but the formidable descent and the ensuing desert journey were before us, and certainly the reign of perpetual winter around us grew as hard to bear as the heats of the desert summer had been. On September 10 we sent our instruments and the escort back by the former route, and, ourselves unencumbered, started on the adventurous descent of the eastern precipices by a downward climb, which, if successful, would carry us to the plains in a single day. I at least shall never forget that day, nor the scenery of more than Alpine grandeur which we passed in our descent, after first climbing by frozen lakes in the northern shadow of the great peak, till we crossed the eastern ridges, through a door so narrow that only one could pass it at a time, by clinging with hands and feet as he swung round the shoulder of the rocks—to find that he had passed in a single minute from the view of winter to summer, the prospect of the snowy peaks behind shut out, and instantly exchanged for that below of the glowing valley and the little oasis where the tents of the lower camp were still pitched, the tents themselves invisible, but the oasis looking like a green scarf dropped on the broad floor of the desert. We climbed still downward by scenery unique in my recollection. This view of the ravine on the screen is little more than a memorandum made by one of the party in a few minutes' halt part-way down, as we followed the ice-stream between the tremendous walls of the defile which rose 2000 feet, and between which we still descended, till, toward night, the ice-brook had grown into a mountain torrent, and, looking up the long vista of our day's descent, we saw it terminated by the Peak of Whitney, once more lonely in the fading light of the upper sky.

This site, in some respects unequalled for a physical observatory, is likely, I am glad to say, to be utilised, the President of the United States having, on the proper representation of its value to science, ordered the reservation for such purposes of an area of 100 square miles about and inclusive of Mount Whitney.

There is little more to add about the journey back to civilisation, where we began to gather the results of our observation, and to reduce them—to smelt, so to speak, the metal from the ore we had brought home—a slow but necessary process, which has occupied a large part of two years.

The results stated in the broadest way mean that the sun is blue—but mean a great deal more than that; this blueness in itself being perhaps a curious fact only, but in what it implies, of practical moment.

We deduce in connection with it a new value of the solar heat, so far altering the old estimates that we now find it capable of melting a shell of ice sixty yards thick annually over the whole earth, or, what may seem more intelligible on its practical bearings, of exerting over one horse power for each square yard of the normally exposed surface. We have studied the distribution of this heat in a spectrum whose limits on the normal scale our explorations have carried to an extent of rather more than twice what was previously known, and we have found that the total loss by absorption from atmosphere is nearly double what has been heretofore supposed.

We have found it probable that the human race owes its existence and preservation even more to the heatstoring action of the atmosphere than has been believed.

The direct determination of the effect of water-vapour in this did not come within our scope; but that the importance of the blanketing action of our atmospheric constituents has been in no way overstated, may be inferred when I add that we have found by our experiments that if the planet were allowed to radiate freely into space without any protecting veil, its sunlit surface would probably fall, even in the tropics, below the temperature of freezing mercury.

I will not go on enumerating the results of these investiga- [illegible] they all flow from the fact, which they in turn confirm, [illegible] limpid sea above our heads, and about us, is carrying on a wonderfully intricate work on the sunbeam, and on the heat returned from the soil, picking out selected parts in hundreds of places, sorting out incessantly at a task which would keep the sorting demons of Maxwell busy, and as one result, changing the sunbeam on its way down to us in the way we have seen.

I have alluded to the practical utilities of these researches, but practical or not, I hope we may feel that such facts as we have been considering about sunlight and the earth's atmosphere may be stones useful in the future edifice of science, and that if not in our own hands then in those of others, when our day is over, they may find the best justification for the trouble of their search, in the fact that they prove of some use to man.

May I add an expression of my personal gratification in the opportunity with which you have honoured me of bringing these researches before the Royal Institution, and of my thanks for the kindness with which you have associated yourselves for an hour, in retrospect at least, with that climb toward the stars which we have made together, to find, from light in its fullness, what unsuspected agencies are at work to produce for us the light of common day.

## *ZOOLOGICAL RESEARCH*[1]

THE *Vettor Pisani* is soon expected in our port, on her return from a long voyage of no little scientific importance. We think we cannot better hail her arrival than by publishing that portion of Prof. Dohrn's report in which he speaks of the scientific mission fulfilled by this vessel—a mission which, besides meeting with a success far surpassing the highest expectations, has redounded not a little to the benefit of our "Stazione Zoologica."

The time has now arrived, writes the illustrious Professor, for me to speak of an event which took place towards the end of 1881, and which has since borne no inconsiderable fruit. And this, in its turn, takes me back to a conversation which I had in 1878 with the Italian Minister of Marine. I had already proposed that, instead of sending out a young naturalist on board the frigates which sail around the world, a young naval officer should be sent to the "Stazione Zoologica," where, in about four months, he might pick up so much knowledge as would enable him to collect and preserve specimens of marine animals. Owing to a change in the Ministry, my proposition, though accepted in the main, was forgotten; and I only succeeded in getting it put into execution in 1881.

On December 27, 1881, a young naval lieutenant, Signor Gaetano Chierchia, a Neapolitan by birth, introduced himself to me with these words: "I have been sent by the Ministry to learn under your direction at the 'Stazione Zoologica' how to collect and preserve specimens of marine animals. I present myself accordingly, and beg to be allowed to begin work at once." These few words, modest, yet full of energy, made a deep impression on me; for they not only marked the beginning of a new epoch in the active life of the Zoological Station, but also promised a more intimate connection between it and the officers of the Italian navy—an intimacy to which I had looked forward from the very day in which I conceived the idea of the future floating Zoological Station.

With the same modest energy which characterised his first interview with me, Signor Chierchia continued for four months his studies under the special direction of the Curator, Salvatore Lobianco; and all the employes and naturalists of the Zoological Station were astounded at the rapid progress he made in a field so entirely new to him. And when the moment came for establishing my laboratory on board the corvette *Vettor Pisani* (which came most appositely to Naples), and there had been put on board all the fishing apparatus, chemical reagents, alcohol, glass vessels, &c., we accompanied him as a dear friend, and looked forward to results which should mark a distinct advance in the culture of our science. And our expectations, far from being disappointed, were widely surpassed. After only five months there arrived the first consignment—the product of deep sea work, of dredging and coast-fishery along the shores of Gibraltar, Brazil, and Montevideo. The whole collection was in excellent preservation, carefully labelled and packed, and accompanied by a minute report as to the place and circumstances of each find. And I do not for a moment hesitate to affirm that never has so important a collection of oceanic

[1] From the *Pungolo*, April 23, 1885. Naples, Italy.

animals before reached Europe. Scarce four months had elapsed when there arrived a second consignment, still more extensive than the first, and the result of collections made during a voyage from Montevideo to Cape Horn, around the islands of the Patagonian archipelago (a course which the obliging commander of the corvette, Capt. Palumbo, had followed at my especial desire).

This collection, too, contained most interesting specimens, among which are especially worthy of mention a vast number of tubes filled with the produce of deep-sea fishing (pelagic products). In the same way there have come to hand two other consignments from the Peruvian coast, from the Galapagos Isles, from the coast of Panama; and also some most interesting animals found in small pools and rivers in Peru. Among these, of special importance are two complete series of embryonic forms—first, of a Peruvian ray, and secondly of a toad, which Lieut. Chierchia, at my desire, and to aid my studies in the history of the origin of vertebrate animals, reared with great care, and kept in an excellent state of preservation. In this he was assisted by Dionigi Francese, who had been trained in the Zoological Station, and had embarked as a sailor on board the *Vettor Pisani*. The *Vettor Pisani* continued its course from Peru across the ocean towards the Philippine Islands and China, and we may look for a new shipment of specimens. In this we have a striking confirmation of my opinion that zoology might receive material aid in its work from naval officers trained for the purpose, rather than from the employment of young naturalists. The example thus presented has been followed by other individuals, and already three more naval officers, Lieuts. Cercone, Orsini, and Colombo, have been trained in the same way at the Zoological Station. It is a matter for regret that the first-mentioned has made but one voyage, a short one towards the West Indies, in which violent gales were encountered. The result of his researches may be seen at the "Station." Lieut. Orsini is in the colony of Assab, at the mouth of the Red Sea, and has despatched thence a valuable and well-preserved collection. Lieut. Colombo is the only one of the three whose studies have been of a more extensive and continuous nature, and for them opportunity has on several occasions been given him by the Minister of Marine. On board the vessel attached to the Hydrographical Survey, commanded by Capt. Magnaghi (equally well known as a man of science and an officer), he has made excellent collections in the Mediterranean itself, and has now returned once more to the "Stazione" to further prosecute his studies there.

From the very first it has been my intention to invite the naval services of other nations to join us in this line of research, and accordingly, in the autumn of 1882, I proposed to the German Minister of Marine that he should send a naval officer or surgeon to Naples to receive a training such as I have indicated. The head of the Admiralty then, Herr Von Stosch, accepted my proposal, and sent a naval surgeon, Dr. Sander, for four months to Naples. In the autumn of the following year Dr. Sander embarked on board the frigate *Prinz Adalbert* for Eastern Asia. We still await its arrival, and hope for valuable results from the expedition.

A preliminary conversation which I had last summer at St. Petersburg with the head of the staff of the Russian Marine Admiral Tchechatchoff, leaves room for hope that Russia too will consent to join us in the matter, and that so in the course of a few years we may look for a still further and wider development of this connection between the "Stazione Zoologica" and the various marine war services of the world. From such a connection great advantages would accrue, not only to science in general, but also to the naturalists of those several countries, which in their turn would be the richer for the collections made by their respective navies.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE*

CAMBRIDGE.—There will be an examination in certain branches of natural science for minor scholarships at Downing College, on Tuesday, June 2 next, and following days. Persons who have not entered at any college in the University are eligible to the minor scholarships, which will be of the value of from 40*l.* to 70*l.* per annum, and tenable until their holders are of standing to compete for a Foundation Scholarship. Further information will be given by Dr. Perkins or the Rev. J. C. Saunders, tutors of the College.

## *SCIENTIFIC SERIALS*

*Annalen der Physik und Chemie*, No. 3, March, 188[illegible]. R. W. Bunsen, on capillary absorption of gas. Shows [illegible] dependence between the capillary pressures and the vo[illegible] gas absorbed. This discovery, doubtless, has importa[illegible] tions in physiological processes. Prof. G. Quincke, [illegible] researches (No. 10), on the measurement of magnetic [illegible] hydrostatic pressure. The author adopts the formula

$$p = \mathfrak{K}_1 H_1^2/8\pi,$$

where $H_1$ is the intensity of the magnetic field, and $\mathfrak{K}_1$ [illegible] magnetisation constant" analogous to the dielectric con[illegible] the analogous formula for the pressure in the electric fiel[illegible] servations have been made on many magnetic liquids t[illegible] tain the numerical values of this constant.—O. Lummer, [illegible] theory and form of some newly-observed interference [illegible] These relate to certain phenomena of thick plates.—C. Ch[illegible] sen, researches on the optical properties of finely-divided [illegible] —W. Moller, on Wild's photometer.—E. and L. Natan[illegible] the dissociation of the vapour of hyponitrous acid.—M. T[illegible] researches on the equation of state; a discussion of the [illegible] gaseous pressure.—Prof. L. Pfaundler, on the action of st[illegible] compressed carbonic acid on glass under the influence of [illegible] W. Voigt, reply to Prof. Wullner's remarks respecting J[illegible] observations on metallic reflection.

*Journal of the Russian Chemical and Physical Society*, vo[illegible] fasc. 9.—On the oxidation of acetones (second memoir), [illegible] Wagner. The behaviour of ketones in chromic acid mixtu[illegible] described, and the general laws of their oxidation are ded[illegible] —On the action of the iodides of allyl and zinc on [illegible] chloridnne, by M. Lopatkin.—On isopropyl allyl dim[illegible] carbinol, by M. Kononovich.—On the relation between [illegible] magnetism and the temperature of fusion of bodies, b[illegible] Bachmetieff. The absolute heat of fusion being represente[illegible] the equation $W = (t + 273)(c + b)$, where $c$ is the specific [illegible] $b$ the latent heat of fusion, and $s$ the specific weight of the b[illegible] then, the series $(t + 273)s$ being taken according to the fi[illegible] of Regnault and M. Carnelley, it appears to be in reverse [illegible] to Faraday's diamagnetic series, the bodies appearing in [illegible] following series which culminates with Bi and Sb:—K, [illegible] P, Br, S, Mg, Ca, I, Al, In, Sn, Bi, Sb, Zn, Cd, Pb, Ag, [illegible] Pd, Au, Cr, W, Pt, Ir, Os.—On the atmospheres of pla[illegible] the temperature of the sun in cosmic space, and the earth's a[illegible] sphere, by E. Rogovsky.—On some new demonstrations of [illegible] conditions for a minimum of deviation of a prism, by [illegible] Poltechikoff.—A note in answer to M. Stankevitch, by the sa[illegible] —Studies in cosmical physics: III. the heating of meteo[illegible] when falling on to the earth, by Th. Schwedoff.—Answering t[illegible] objection made at the British Association of 1882 by Sir Will[illegible] Thomson to his cosmic theory of hail, the author discusses [illegible] heat which a meteoric stone may receive when piercing [illegible] atmosphere. He shows by several examples, by our experie[illegible] of meteorites, and by M. Daubree's testimony, that they ne[illegible] have been brought to fusion. The meteorite must be compa[illegible] to a fire syringe (*briquet pneumatique*), which condenses the [illegible] and raises its temperature, remaining nearly cold itself when [illegible] conducting power is feeble. The *vis viva* of the meteorite [illegible] spent in piercing the layers of air—that is, in bringing them i[illegible] motion (like a bullet which would spend its force in pierci[illegible] 1000 sheets of paper before reaching the target), and to adm[illegible] that its *vis viva* be transformed into heat, would be to forget t[illegible] force spent in piercing the air.—Index to the sixteenth volume[illegible]

*Bulletin de la Société des Naturalistes de Moscou*, 1884, No. [illegible] —Materials for the flora of Central Asia, by Prof. N. Sorokin[illegible] After having twice visited several parts of Russian Turkist[illegible] and the delta of the Amu-daria, M. Sorokine returned with [illegible] rich collection of phenogams, which proved this part of t[illegible] Central Asian flora to be very rich, original, and interesting[illegible] The department of Gasteromycetes alone offered the great[illegible] interest, on account of its containing forms peculiar to Algeri[illegible] Egypt, Cuba, and so on. There are even several indices whic[illegible] would seem to indicate that the Aral-Caspian region has been [illegible] centre of dispersion of several forms, whose spores were tran[illegible] ported by winds across the Red Sea to Africa, and thence to Spa[illegible] and France. The whole work of the author could not be pub[illegible] lished at once, on account of its numerous plates. The descrip[illegible] tion of the Chytridiaceae has appeared in the *Archives botaniques du Nord de la France*, the remainder will appear in the Moscow *Bulletin*, which contains now the description, with five plates[illegible] of the Hypodermei and the Gasteromyceies.—Plantæ Raddeanæ Monopetalæ, by Ferd. von Herder (continued).—Solution of a problem of the theory of comets, by N. Joukovski (Russian). The geocentric position of a particle of the tail which has left the nucleus since a given time under the action of a given repulsive force, to determine the displacement of the particle for a given change in the repulsive force—such is the problem treated. —Analyses of salt and mud from a volcano of Trans-Caucasia. —An essay on the solution of the geodetical problem, by Th. Sloudsky (in French). The already-known formulæ already give the possibility of embodying all anomalies less than 30" in latitude and less than 15 oscillations of the pendulum in twenty-fours against the calculated ones. The author tries, however, to give a more theoretical formula, which might at the same time embody larger anomalies.—List of the herbaria of the Moscow University and of the Society of Naturalists, by J. Goroshankin.—Studies on the averages of the relative moistness, by Dr. K. Weihrauch (continued; in German).—Necrology and Annual Report.

*Rendiconti del R. Istituto Lombardo*, March 26.—History of the first century (1783-1883) of the Reale Istituto, by G. B. Venturi.—On the persistence of the thymus gland in children and adults, by Prof. Giovanni Zoja.—Account of a successful operation performed on a young girl for the purpose of closing an open sore on the left cheek produced by a severe attack of typhoid fever.—Further notes on conformable representations in higher mathematical analysis, by Prof. Giulio Ascoli.—Meteorological observations made at the Royal Observatory of Brera, Milan, during the month of March.

*Rivista Scientifico-Industriale*, March 31.—A new explanation of the red crepuscular lights that have been attributed to the Krakatoa eruption, by Prof. Carlo Marangoni.—Variations in the electric resistance of solid and pure metallic wires according to the temperature (continued), by Prof. Angelo Emo.—A visitation of caterpillars (*Lithosia caniola*, Hl.) in Florence during the present season, by P. Bargagli.

## SOCIETIES AND ACADEMIES

### London

**Royal Society**, April 23.—"On the Changes produced by Magnetisation in the Length of Rods of Iron, Steel, and Nickel." By Shelford Bidwell, M.A., LL.B.

The earliest systematic experiments on the effects produced by magnetisation upon the length of iron and steel bars are those of Joule, an account of which is published in the *Phil. Mag.* of 1847. Joule's experiments have many times been repeated, and his general results confirmed. In particular, Prof. A. M. Mayer carried out a series of very careful observations with apparatus of elaborate construction and great delicacy. The conclusions at which he arrived were in accord with those of Joule, so far as regards iron; in the case of steel there was some apparent discrepancy, which, however, might to a great extent be accounted for by differences in the quality of the metal used and in the manner of conducting the experiments. In 1882 Prof. Barrett published in NATURE an account of some experiments which he had made, not only on iron but also on bars of nickel and cobalt, with the view of ascertaining the effect of magnetisation upon their length.

The knowledge on the subject up to the present time may be summarised as follows:—

(1) Magnetisation causes in iron bars an elongation, the amount of which varies up to a certain point as the square of the magnetising force. When the saturation-point is approached the elongation is less than this law would require. The effect is greater in proportion to the softness of the metal.

(2) When a rod or wire of iron is stretched by a weight, the elongating effect of magnetisation is diminished; and if the ratio of the weight to the section of the wire exceeds a certain limit, magnetisation causes retraction instead of elongation.

(3) Soft steel behaves like iron, but the elongation for a given magnetising force is smaller (Joule). Hard steel is slightly elongated, both when the magnetising current is made and when it is interrupted, provided that the strength of the successive currents is gradually increased (Joule). The first application of the magnetising force causes elongation of a steel bar if it is tempered blue, and retraction if it is tempered yellow: subsequent applications of the *same* external magnetising force cause temporary retraction, whether the temper of the steel is blue or yellow (Mayer).

(4) The lengh of a nickel bar is diminished by magnetisation, the maximum retraction being twice as great as the maximum elongation of iron (Barrett).

In order that the results of Joule and Mayer might be comparable with those obtained by the author, he made an attempt to estimate the magnetising forces with which they worked. From data contained in their paper, it was calculated that the strongest magnetising force used by Joule was about 126 units, while the strongest used by Mayer did not on the highest probable estimate exceed 118 units. In the author's experiments the magnetising force was carried up to about 312 units. The metal rods, too, were much smaller than any which had been before used for the purpose, ranging in diameter from 1·40 to 6·25 mm. Their length was in every case 100 mm., and the apparatus was capable of measuring with tolerable certainty an elongation or retraction equal to a ten-millionth part of this length.

By using thinner iron rods and greater magnetising forces than those previously employed, the following curious and interesting fact was established. If the magnetisation be carried beyond a certain critical point, the consequent elongation, instead of remaining stationary at a maximum, becomes diminished, the diminution increasing with the magnetising force. If the force is sufficiently increased, a point is arrived at where the original length of the rod is totally unaffected by magnetisation; and if the magnetisation be carried still further, the original length of the rod will be reduced. It also appeared that the position of the critical point in steel depended in a very remarkable manner upon the hardness or temper of the metal; considerable light is thus thrown on the apparently anomalous results obtained by Joule and by Mayer. Further experiments disclosed strong reason for believing that the value of the critical magnetising force in a thin iron rod was greatly reduced by stretching; this would explain the fact that Joule obtained opposite effects with stretched and unstretched wires.

By ascertaining the relative values of the temporary moments induced by gradually increasing external magnetising forces, an attempt was made to connect the point of maximum elongation with a definite phase of the magnetisation of the several rods in which the elongation had been observed.

Though more experiments must be made before it is possible to generalise from them with perfect safety, the results so far obtained by the author indicate the laws given below. The elongations and magnetisations referred to are temporary only; before the beginning of an experiment the rod was permanently magnetised by passing through the magnetising coil a current equal to the strongest subsequently used. In iron the greatest elongation due to permanent magnetisation was generally found to be about one-third of the total elongation, while in nickel the permanent retraction amounted only to about one-twenty-fifth part of the whole.

#### I. Iron

(1) The length of an iron rod is increased by magnetisation up to a certain critical value of the magnetising force, when a maximum elongation is reached.

(2) If the critical value of the magnetising force is exceeded, the elongation is diminished until with a sufficiently powerful magnetising force the original length of the rod is unaffected, and, if the force is still further increased, the rod undergoes retraction. Shortly after the critical point is passed, the elongation diminishes in proportion as the magnetising force increases. The greatest actual retraction hitherto observed was equal to about half the maximum elongation, but there was no indication of a limit, and a stronger magnetising force would have produced further retraction.

(3) The value of the external magnetising force corresponding to maximum elongation is for a given rod approximately equal to twice its value at the "turning point."

*Definition.*—The turning point in the magnetisation of an iron bar is reached when the temporary moment begins to increase less rapidly than the external magnetising force.

(4) The external force corresponding to the point of maxim[um] elongation increases (when the quality of the iron is the sa[me]) with the diameter of the rod. So also does its value at turning point.

(5) The amount of the maximum elongation appears to v[ary] inversely as the square root of the diameter of the rod, when t[he] quality of the iron is the same.

(6) The turning point, and therefore presumably the point of maximum elongation, occurs with a smaller magnetising force when the rod is stretched than when it is unstretched.

II. STEEL

(7) In soft steel magnetisation produces elongation, which, as in the case of iron, increases up to a certain value of the magnetising force, and afterwards diminishes. The maximum elongation is less than in iron, and the rate of diminution after the maximum is passed is also less.

(8) The critical value of the magnetising force for a steel rod diminishes with increasing hardness up to a certain point, corresponding to a yellow temper; after which it increases, and with very hard steel becomes very high. There is therefore a critical degree of hardness for which the critical magnetising force is a minimum: in steel of a yellow temper the value of the critical magnetising force is lower than in steel which is either softer or harder.

(9) In soft steel a strong magnetising force subsequently diminished may cause a greater temporary elongation than the diminished force is capable of producing if applied in the first place.

(10) A temporary elongation when once produced in soft steel may be maintained by a magnetising force which is itself too small to originate any perceptible elongation.

III. NICKEL

(11) Nickel continues to retract with magnetising forces far exceeding those which produce the maximum elongation of iron. The greatest observed retraction of nickel is more than three times the maximum observed elongation of iron, and the limit has not yet been reached.

(12) A nickel wire stretched by a weight undergoes retraction when magnetised.

**Anthropological Institute**, April 28.—Francis Galton, F.R.S., President, in the chair.—Mr. A. L. Lewis read a paper on the past and present condition of certain rude stone monuments in Westmoreland. The highest point of the railway between Lancaster and Carlisle is a little to the south of the village and station of Shap, in Westmoreland, where there were formerly some very extensive rude stone monuments, now unfortunately almost entirely destroyed. Allusion is made to them by Camden and Dr. Stukeley, and a circle is said to have been destroyed when the railway was made; some remains of this circle may be seen from the train, but only a few stones are left on the spot. The most interesting monument now remaining in the vicinity of Shap is situated at a place called Gunnerskeld, two or three miles to the north, and consists of two irregular, concentric, slightly oval rings, about 50 and 100 feet in diameter respectively, the longest diameters being from north to south.—A paper by Admiral F. S. Tremlett on quadrilateral constructions near Carnac was read. These enclosures were explored by the late Mr. James Miln: in each case the boundary walls are formed of course, undressed stones, put together without any kind of cement, and having built up in them a series of small menhirs; they also contained beehive structures for cremation, reddened and become friable from the effects of great heat. It would appear that the cremation had been perfect, as not a particle of calcined bone was found in either of the enclosures.—A paper by M. Jean L'Heureux on the Kekip-Sesoators, or ancient sacrificial stone of the North-West Territory of Canada, was read. Elevated two hundred feet above the level of the surrounding plain, Kekip-Sesoators, the Hill of the Blood Sacrifice, stands like a large pyramidal mound commanding an extensive view of both Red Deer and Bow River Valleys. A natural platform of about one hundred feet crowns its summit; at the north end of the platform, resting upon the soil, is the Sesoators, a rough boulder of fine-grained quartzose, fifteen inches high and about fourteen in diameter; upon its surface are sculptured half an inch deep the crescent figure of the moon with a shining star over it. Two small concave basins about two inches in diameter are hollowed into the stone, one in the centre of the star, the other about seven inches from it in a straight line; around them are traced various hieroglyphic signs, and all over the surface are numerous small circlets, which remind one of the sacrificial stone of Mexico. Here at a time of private or public necessity, when extraordinary blessings are sought, comes a solitary warrior, himself the priest and the victim; from the time of sunset he is in solemn vigil gazing in the far east for the coming of the star god of his ancestors; and when the first ray of the morning star lights the distant horizon, he lays a finger of his left hand on the top of the stone and cuts it off, leaving the blood to flow into the basin. He then presents the bleedi[ng finger to the] morning star, and, leaving it in the basin of the [stone] retraces his steps towards the lake at the foot of [the hill] he dresses his wound, and at sunrise enters hi[s camp] where he is received with triumphant honours. [Among the] Blackfeet these self-inflicted wounds ranked e[qual to wounds] received in battle, and are always mentioned first [in the] recital of the warrior's great deeds in the national [...]

**Geologists' Association**, May 1.—William T[...] President, in the chair.—A paper was read on w[...] recent and fossil—and on birds as a class, b[y Henry] Woodward, F.R.S. The author prefaced his rem[arks on fossil] less birds by giving first a brief account of the char[acters of birds] as a class. He described the peculiarities of the [...] fore- and hind-limb, the cervical, thoracic, sacra[l ...] vertebrae, with the shoulder-girdle and pelvis. [...] the highly-specialised fore limbs in existing birds [...] *Archaeopteryx*, the former, with three rudimentary [...] the metacarpal bones anchylosed together; the lat[ter ...] free digits in each manus, armed with claws. He [...] bones of the hind limb of an adult *Iguanodon* w[ith ...] young *Dinornis*, and showed how closely the chara[cters ...] able in the former are repeated in the latter. Ma[ny ...] analogies were also pointed out in the form of the [...] and pelvis in *Struthio* and Iguanodon. The [...] although possessing so many points of divergence fro[m ...] type, was shown to be the earliest known ancestor [...] division of *Carinatae* (birds with a keel to the stern[um]) [...] nearly all modern (flying) birds belong. For the [flat-] [...] breasted birds), to which division the Ostrich, [...] Cassowary, Apteryx, Dinornis, Aepyornis, &c., belon[g ...] ancestor must be sought. The author contended [...] evidence before us we have a right to claim a hig[her antiquity] for the *Ratitae* than for the *Carinatae*, not only fro[m ...] wide distribution of this division of the class, but [...] fossil evidence which embraces for the Struthious [...] still larger geographical area than that shown fo[r ...] species. And if we are at liberty to add to this the[...] the footprints of bipedal animals in the Trias (whi[ch ...] the tracks of birds in the number of digits in the foot [...] footprints may be taken as further evidence of their [...] geological time. For the primitive forms of this cl[ass we must] evidently look to the palaeozoic rocks.

**Zoological Society**, May 5.—Prof. Alfred Newto[n, F.R.S.,] Vice-President, in the chair.—A communication wa[s read from] Mr. Jean Stolzmann, containing observations on th[e ...] sexual dimorphism.—Mr. J. Bland Sutton, F.Z.S., [read a paper] on hypertrophy and its value in evolution, in which he [attempted] to show that material changes in structure might be [...] what was originally a pathological condition.—[...] Newton, F.Z.S., read a paper on the remains of [a] species of bird (*Gastornis* ...) which had been [...] Mr. H. M. Klaassen from the "Woolwich and Rea[ding ...] of the lower Eocene series. The author observed [...] bones proved that in early Eocene times England wa[s inhabited] by a race of birds which equalled in their proportio[ns ...] the more massive forms of the New Zealand moa[s.—A com-] munication was read from Mr. R. B. Sharpe, F.Z.S[., contain-] ing the description of a new species of Hornbill fro[m the island] of Palawan, which he proposed to name *Anthracoceros* [...]

Prof. E. Ray Lankester, F.R.S., read some no[tes on the] right cardiac valve of the specimen of *Apteryx* dissect[ed by Sir] Richard Owen in 1842.—A communication wa[s read from] Lieut.-Col. C. Swinhoe, F.Z.S., being the third of h[is] papers on the Lepidoptera of Bombay and the Dec[can. The] present paper treated of the second portion of the Het[erocera.—] A communication was read from Dr. St. George Mivar[t, F.R.S.,] containing a correction of a statement concerning the [...] of *Viverricula*, contained in a former paper.

MANCHESTER

**Literary and Philosophical Society**, Feb. 16.—[...] Alcock, M.D., in the chair.—A proposed revision of t[he species] and varieties of the sub-genus Cylichna, Moerl. (and C[...]), by Mr. J. Cosmo Melvill, M.A., F.L.S.

March 10.—Prof. W. C. Williamson, LL.D., F.R.[S., Presi-]dent, in the chair.—On making sea-water potable, b[y ...] Key, President of the Stockport Natural History [Society.] Communicated by F. J. Faraday, F.L.S.

March 16.—Thomas Alcock, M.D., in the chair.—[On the] breeding of the Reed Warbler (*Acrocephalus arundin[aceus]*) [...]

eshire, by Francis Nicholson, F.Z.S.—On *Lagena crenata*, Dr. Alcock.—The Post-Glacial Shell-beds at Uddevalla, eden, by Mark Stirrup, F.G.S.

PARIS

**Academy of Sciences**, May 4.—M. Bouley, President, in chair.—Summary of the meteorological observations made ing the year at four stations on the Upper Rhine and in the sges district (Schlucht, Munster, Colmar, and Thann), by M. A. Hirn. Tables are given of the actinometric observans, of the prevailing winds with their mean and greatest ocities, of the mean and extreme temperature, of the atmoieric pressure and rainfall for each month of the year at all se stations. During the period in question the most salient enomena were the severe frosts of the month of April, which oved very destructive, especially to the vines, and the sudden d violent hurricane of July 16, which swept with tremendous oidity over the Vosges, almost unaccompanied by rain, and th very little thunder.—Remarks on the influence exercised seismatic disturbances on Phylloxera, by M. S. Villalongue. ne case is mentioned of a vineyard near Malaga affected by is parasite and supposed to have been destroyed, which neverеless broke into leaf with fresh vigour after the earthquakes hich recently devastated the southern provinces of Spain.—pplication of the general laws of the theory of the partition numbers to numerical functions, by M. N. Bougaieff.—On an sy method of controlling the velocity of electric motor currents ne illustration), by M. Marcel Deprez.—Note on the suppression the nitrous vapours of the Bunsen pile, and on a new pile which ecomes depolarised in the atmosphere, by M. A. d'Arsonval.—n a new variety in the anomalous group of Cyclocephalians, y M. A. Lavocat. This variety, for which the term "ophthalocephalous" is proposed, is illustrated by the recent case of a ill-born lamb, in which nose and eyes were entirely absent, d, in place of the orbits, showing in the median plane a cavity rmed by the union of the two temporal fosses. At the same me the tongue, the ears, and all the parts corresponding with ese organs were in the normal state.—On the system of canalation present in the cellules of plants, and on the continuity of e protoplasm in vegetation, by M. L. Olivier. In opposition the generally accepted views, the author infers from his microopic studies that in the thickness of the membranous walls of ants there is a highly developed network of canals, by means which the continuity of the protoplasm is effected throughout e cellular system.—An attempt to determine the relative age the Grand'-Combe Carboniferous deposits by means of their ssil vegetation, by M. R. Zeiller.

ROME

**Reale Accademia dei Lincei**, January 4.—On pleasurble and periodic respiration. Prof. Mosso communicated abstract of a memoir in which he expounds various bservations made by him on respiration. By means of acings taken from a man in a state of complete rest, e has recognised that in the respiratory movements periods of reater or less depth in breathing alternate with one another, and at such periods are observable in all animals, especially during eep. The author has likewise ascertained that man breathes a reater quantity of air than is necessary, and it is that respiraon that he calls pleasurable (*respirazione di lusso*). It is in onsequence of this excess in the ordinary breathing that a man oes not increase the extent of his respiratory movements in scending a mountain or in undergoing a change of atmospheric ressure. Prof. Mosso has determined the limit of this pleasurble respiration which is manifested in sleep when no cause ould render it necessary. According to the pauses which the eriodic respiration undergoes, the author divides it into *remittent* (*remittente*) and *intermittent* (*intermittente*). These pauses o not depend on the movements of the blood-vessels nor on sychical factors. It is a recognised fact that respiration has ot a single centre, but that various muscles subserve this funcion independently of each other. Prof. Mosso concludes that ot only is periodic respiration a normal physiological phenonenon, but that it is nothing else than the respiration of Cheyne nd Stokes, which has hitherto been looked upon as a morbid ondition. The author closes his own paper with a critical eview of the theories of the nature of the movements of respiration.—Other communications:—Dr. Piccini described the nalyses and the methods of preparation of certain fluor salts of itanium, corresponding to the sesquioxide, which had been obtained by him.—Drs. Ciamician and Silber described the results of the action of nitric acid on pyril-methyl-ketone.—Drs. Ciamician and Magnaghi communicated a first note on the action of carbonyl chloride on the potassic compound of pyrrol.—The sanction of the Academy was likewise given to the printing, in the *Atti Academici*, of a memoir by Prof. Belloni, in which the author describes the olfactory and olfactory-auditory apparatus of the teleosteans (the *nuclei rotundi* of Fritsch).—The Secretary, Signor Blaserna, read a communication by Signor Laure, in which the author insists on the necessity of paying great attention to the barometric variations in cases of earthquakes and volcanic eruptions.

January 18.—Articles belonging to the Stone Age discovered in the commune of Breonio Veronese. Prof. Pigorini observed that of all the localities containing remains of the Stone Age Breonio Veronese is the most interesting and the richest, on account of its numerous caves in which primitive man has left his traces. The numerous flint implements found in that locality were attributed by ancient writers to the Cimbri. Some of these have common forms, but others are of very singular shape, and the use of the latter cannot be determined. The importance of such articles, which are found also in the sepulchres of the Stone Age near the caves, but which are there reproduced almost in miniature, consists in the fact that articles of the same form are found among the remains belonging to the prehistoric American stations, which leads us to surmise the existence of a bond of connection in the earliest times between the inhabitants of the Old World and the New. Prof. Pigorini, while dwelling on the great value of the collection of such curiously-shaped articles made by Signor S. de Stefani, and described by him before the Congress at Venice, was glad to be able to announce to the Academy that the collection had been acquired by Prof. Landberg, whose attachment to Italy and whose philanthropic character were well known, and that it was his generous intention to present the collection to the Prehistoric and Ethnographical Museum at Rome. This valuable scientific material is thus to remain in Italy.—On the observations on the solar maculæ and faculæ made in the Observatory of the Collegio Romano in 1884. From the observations made, Signor Tacchini believed that he could conclude that the solar activity was diminishing and that it would very soon reach its minimum. Comparing the observations of 1883 with those of 1884, he found that in 1884 chromospherical phenomena attained a considerable development. Signor Tacchini, although he has not yet completed his labours in reducing the observations, is of opinion that 1884 will have to be remembered as a year of maximum frequency of hydrogenic perturbations, but he intends to return to the question when he has completed the calculations relating to it.—On an ancient vase representing Sappho.—Signor Comparetti read some preliminary notes regarding an ancient vase belonging to the collection of the Archæological Society of Athens. On this vase, the drawing on which is rather rude, Sappho is represented in the midst of her disciples, she herself being in the act of reading some epic lines written on a roll held in her hand. This vase belongs to the fourth century B.C., and hence to the period in which Sappho was most popular in the refined and gallant society of Athens. According to Prof. Comparetti, the two disciples who are listening to Sappho, must, judging from their names which are written on the vase, be two Athenian hetæræ.—Discovery of an ancient encyclopædia, and the plagiarism practised on it. Signor Narducci announced that he had discovered in the Biblioteca Angelica, at Rome, a parchment MS. belonging to the end of the thirteenth century, containing in its first 129 pages an encyclopædia, hitherto unknown, compiled by Egidio Colonna, of Rome. After giving an account of the contents of this work, Signor Narducci drew attention to the shameless manner in which the encyclopædia of Colonna had been plagiarised by the Englishman Bartholomew Glanville, commonly called *Bartholomeus Anglicus*, who flourished about 1630. This writer acquired the greatest reputation by a book of his called "Liber de proprietatibus rerum," which is in great part copied word for word from the encyclopædia of Colonna.—Other communications: Signor Fiorelli gave an account of the excavations of antiquiti made during the month of December.—Dr. Nasini made a co munication regarding some researches he had made on atomic refraction of sulphur, and on the higher value of t refraction.—Dr. Piccini read a note containing some gene considerations on peroxides of the type of peroxide of hydroge and made a communication as to the continuation of his re searches on a new series of titanium compounds.

February 1.—On the hydrogenic protuberances of the sun, observed at the Royal Observatory of the College of Rome in 1884.—Prof. Tacchini, in continuation of his previous note to the effect that 1884 must be considered as a year in which the phenomena of the chromosphere had attained their maximum development, presented the results of observations made by him on 242 days. From these it appeared that the number of the protuberances increased from March to October. In order to get rid of the anomalies which are met with in various observations, and to obtain a curve representing the course of the phenomena in the quinquennial period 1880 to 1884, Prof. Tacchini has taken as monthly means the means of three months, considering each month along with the month before and after it. The curve so constructed shows three culminating points or periods of maximum activity, these corresponding to July, 1880, September to October, 1881, and March, 1884, which last is the highest in the whole series. The maximum of the protuberances follows that of the sunspots, and recent observations make it probable that 1885 will be a year of greater activity in the chromosphere and solar atmosphere.—On the degree of precision in the determination of the density of gases. Dr. Agamennone stated that the first to experiment with a certain amount of success on the density of gases were the physicists Dumas and Boussingault, and that Regnault had introduced the most important improvements in the methods of working adopted by them. He observed, however, that even these improved methods of Regnault were not exempt from certain errors, the nature of which the author pointed out and described, indicating the precautions that had to be used in the various operations of weighing, in order to avoid some of these errors by taking advantage of the accurate instruments which we possess at the present day. The author insisted specially on the constant source of error proceeding from the property which glass has of condensing gases on its surface, and on the exactness of measurement required in determining the pressure at which the gas to be weighed is contained in the vessel in which the weighing is effected. Dr. Agamennone has repeated in the Royal Physical Institute of Rome all the experiments of Regnault, and, correcting an error found in one of the experiments of that physicist, he finds that for the value of the weight of a litre of air, which, according to the corrections made by Kohlrausch and Lasch, would be 1·292756 grammes, there ought to be substituted 1·292767 grammes—a determination which, according to Dr. Agamennone, is subject to a maximum uncertainty of about ± 0·0005 gramme, and to a mean uncertainty of ± 0·000067 gramme.—Determination of the density of the air. Dr. Agamennone having in his previous paper shown how in the determination of the density of gases the errors affecting the final result proceed from the measurements of weight and pressure, announced that he had executed two series of experiments for the determination of the density of the air, making use of weights and pressures separated from one another by pretty wide limits. The pressures employed in the two series of experiments were: (1) that of the atmosphere, and (2) one of two atmospheres. The author, after describing his methods of procedure and the precautions taken by him, communicated his results, which showed a great difference between the mean values of his two series, and that because the air under pressure departs from Mariotte's law. Dr. Agamennone concludes that when the density of a gas is to be determined, the gas being weighed in a compressed state, it is necessary above all to know by direct experiments the variations in volume of the gas operated on, and to know what amount of condensation there is on the walls of the vessel in which the gas is compressed. For the determination of the deviation of a gas from Mariotte's law, which is a matter of so much importance in researches of this kind, the gas might be weighed at different pressures in a resisting vessel with a sufficiently delicate balance. Some experiments of Regnault have shown this method to be sufficiently satisfactory.—Consequences of a new hypothesis of Kohlrausch on thermo-electric phenomena. Dr. Battelli, after giving a *résumé* of the theoretical explanations offered by Thomson and Tait to account for the results obtained experimentally in thermo-electric phenomena, stated also the hypothesis of Kohlrausch on the electrical transport of heat, and showed how, from the conclusions of Kohlrausch, all the formulæ confirmed by experiment might be deduced.—Other communications:—Drs. Ciamician and Silber have continued their studies on the compounds of pyrrol, and explained minutely the method by which they had succeeded in converting pyrrol into pyridin.—Prof. Cavani communicated a paper on the ang spaces.—Dr. Tonelli presented a note on the anal sentation of certain singular functions.—An abstra municated of a memoir by Messrs. Vanecek, entitl Génération des Surfaces et des Courbes gauch Faisceaux de Surfaces."

February 15.—On the worship of stone weap Neolithic age. Signor Pigorini exhibited a singular ment which had been found in one of the caves in the Breonio Veronese, referred to the Neolithic age. triangular form of a lance- or arrow-head, but is of dimensions. It weighs, in fact, 1·720 kilo., and one sides of the triangle is more than 21 cm. in length. be supposed that this colossal spear-head could have as a weapon, chiefly because its dimensions would be a shaft of quite unmanageable size, but also because at its base would have rendered the shafting extrem Signor Pigorini called to mind how, even at the prese common people attributed a celestial origin to the stone—a superstition which also existed among the an there are proofs that at the very time when these wer made they were held as emblems of divinity. The fact, in the Neolithic age, a worship of the axe, since of that weapon are found, of dimensions so small o like that of Breonio Veronese, that they cannot be re anything else than votive offerings.—Concerning a fr a manuscript of Cicero belonging to the ninth century Narducci found, in the Vatican Library, a valuable containing numerous Ciceronian fragments collected by Hadvardo. Signor Narducci transcribed the manus by page, in the hope that, by collating it with the Cicero, now known, he might find some fragments of l of the great orator. After identifying each of the frag found that the compiler had not had at his disposal s works of Cicero known in the Middle Ages, but not at t day. Signor Narducci gave a short specimen of the m with the various readings found at the present day in esteemed versions of the various works of Cicero, announced that Prof. Schwenke is preparing a critical the manuscript in question.

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## Diary of Societies

LONDON

*THURSDAY*, MAY 14

SOCIETY OF TELEGRAPH ENGINEERS, at 8.

MATHEMATICAL SOCIETY, at 8.—An Application of Determinants to the Solution of Certain Types of Simultaneous Equations: Rev. T. C. Simmons.

ROYAL INSTITUTION, at 3.—Natural Forces and Energies: Prof. Tyndall.

*FRIDAY*, MAY 15.

SOCIETY OF ARTS, at 8.—The Golden Road to South-Western China: Prof R. K. Douglas

ROYAL INSTITUTION, at 9.—Cholera: Prof. Burdon Sanderson.

*SATURDAY*, MAY 16.

ROYAL INSTITUTION, at 3.—Organic Septics and Antiseptics: Prof. Odling.

*MONDAY*, MAY 18.

SOCIETY OF ARTS, at 8.—Toilet Soaps: Dr. Alder Wright.

VICTORIA INSTITUTE, at 8.—The Results of Archæological Research in North America.

*TUESDAY*, MAY 19.

ZOOLOGICAL SOCIETY, at 8.30.—On Dinornis Oweni: Prof. Julius von Haast, C.M.Z.S.—Notes on the Pinnipedia: Dr. Mivart, F.R.S.—Report on the Collection of Birds made during the Voyage of the Yacht *Marchesa*. Part IV. On the Collection of Birds from the Island of Sumbawa: Dr. F. H. H. Guillemard.—On Echinoptilum macintoshii, a new Pennatulid from the Japanese Seas: Dr. A. A. W. Hubrecht, C.M.Z.S.

SOCIETY OF ARTS, at 8.—New Britain and the adjacent Islands: Wilfred Powell.

STATISTICAL SOCIETY, at 7.45.—Indian Railways and Wheat Trade: A. K. Connell.

ROYAL INSTITUTION, at 3.—Digestion and Nutrition: Prof. Gamgee.

*WEDNESDAY*, MAY 20.

ROYAL METEOROLOGICAL SOCIETY, at 7.—The Temperature Zones of the Earth in connection with its Biological Conditions: Dr. W. Köppen.—Velocities of Winds and their Measurement: Lieut.-Col. H. S. Knight, F.R.A.S.—Note on Mr. C. Harding's Paper on Wind Velocities: Dr. W. Köppen.—Note on a peculiar Form of Auroral Cloud seen in Northamptonshire, March 1, 1885: Rev. James Davis. Communicated by the President.

SOCIETY OF ARTS, at 8.—American Oil and Gas-Fields: Prof. Dewar.

*THURSDAY*, MAY 21.

ROYAL SOCIETY, at 4.30.

CHEMICAL SOCIETY, at 8.—Calorimetric Method for Determining Small Quantities of Iron: Andrew Thomson, M.A., B.Sc.—On some Compounds of Calcium and Sulphur: V. S. Veley.

ROYAL INSTITUTION, at 3.—Poisons: Prof. C. Meymott Tidy.

*FRIDAY*, MAY 22.

ROYAL INSTITUTION, at 9.—Garrick: W. H. Pollock.

*SATURDAY*, MAY 23.

PHYSICAL SOCIETY, at 3.—Experiments showing the Variations caused by Magnetisation in the Length of Iron, Steel, and Nickel Rods; and on the Spectral Image produced by a Slowly-rotating Vacuum Tube: Shelford Bidwell.—Note on Electrical Symbols, J. Munro.—On Electrolytic Decomposition: J. W. Clark.

ROYAL BOTANIC SOCIETY, at 3.45.

ROYAL INSTITUTION, at 3.—Organic Septics and Antiseptics: Prof. Odling.

Printed by [illegible]AY AND SONS, at 7 and 8, Bread Street Hill, Queen Victoria Street, in the City of London, and Published by [illegible]LLAN AND CO., at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, MAY 14, 1885.

# NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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

No. 812, Vol. 32] THURSDAY, MAY 21, 1885 [Price Sixpence

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## VICTORIA UNIVERSITY.

The Entrance Examination in Arts (Faculty of Medicine) and the Preninary Examination (Faculties of Arts, Science, and Law) will begin on HURSDAY, June 11, at 2 p.m.

Candidates for the Entrance Examination in Arts, if not matriculated, ist produce a letter of recommendation from their last instructor and pay ee of £1. Candidates for the Preliminary Examination must matriculate fore the Examination. The Matriculation Fee is £2, and includes the amination Fee.

Faculties of Arts and Science.—The Intermediate and Final Examinations Degrees will begin on June 11, as above.

Faculty of Law.—The Intermediate and Final Examinations for Degrees l begin on Monday, July 20, at 10 a.m.

Faculty of Medicine.—The Preliminary Examination in Science and the ermediate M.B. Examination will begin on Monday, July 20, and the st Part of the Final M.B. Examination will begin on Friday, July 17, at a.m.

Further information as to these Examinations can be obtained from the gistrar.

ALFRED T. BENTLEY, M.A., Registrar.

Manchester, May, 1885.

## HE YORKSHIRE COLLEGE, LEEDS.

The Cavendish Professorship of Physics will become Vacant by the resigion of Prof. Rücker, M.A., F.R.S., on SEPTEMBER 30 next. pend, £300, with two-thirds of the Fees. Candidates are invited to ford Applications and Testimonials not later than JUNE 1.

Further information will be supplied on application to the Secretary.

THURSDAY, MAY 21, 1885

## THE BRITISH MUSEUM CATALOGUE OF LIZARDS

*Catalogue of the Lizards in the British Museum (Natural History).* By George Albert Boulenger. Vol. I. *Geckonidæ, Eublepharidæ, Uroplatidæ, Pygopodidæ, Agamidæ.* Second Edition. (1885.)

IT would be difficult to name any order of vertebrates more urgently in need of cataloguing than the lizards. The last general work on the group published in any country was Dr. J. E. Gray's Catalogue, which appeared forty years ago, only six years after the completion of the volumes devoted to lizards in Dumeril and Bibron's great work on Reptiles. The additions made in Dr. Gray's Catalogue were considerable, but many of them were of doubtful value. Thus of fourteen new genera therein added by him to the family of Geckoes alone, but three survive in the present edition, the remainder swell the synonymy.

Mr. Boulenger's Catalogue is a boon to herpetologists and to biologists generally, not only because it places within their reach in a few handy volumes descriptions that have hitherto been widely scattered, but also because the classification proposed, whether it be generally accepted or not, is a distinct advance upon the artificial system hitherto in vogue. It is to be hoped that lizards so closely resembling each other as do, for instance, *Gongylus, Ablepharus,* and *Euprepes,* will no longer be classed in three distinct families solely because of trivial differences in the form of the nasal shield and in the development of the lower eyelid. At the same time, as naturalists have but rarely access to a collection of lacertilian skeletons, it is to be regretted that a few diagrams have not been added to the present catalogue, to show the cranial characters and the forms of the vertebræ, clavicles, &c., upon which Mr. Boulenger's families are founded.

A considerable change in some well-known reptilian genera is proposed in the present work, and it is probable that the union, for instance, of *Stellio* and *Trapelus* with *Agama* and of *Bronchocela* with *Calotes* will not be universally acceptable. But no change appears to have been proposed without valid reasons, and the tendency to excessive multiplication of genera on insufficient grounds has become so serious a nuisance in zoology that a diminution in the number is welcome. It is satisfactory to find, on comparison with the catalogue of 1845, that whilst the species attributed to the *Geckonidæ* have increased from 97 to 270, the genera have only augmented in number from 40 (or if *Eublepharis* and *Uroplates,* now placed in other families, be excluded, 38) to 49, whilst the *Agamidæ* which, in the earlier list, comprised 79 species, distributed amongst no less than 34 genera (35, including *Hatteria*) now contain 202 species, but only 30 genera. But six new generic names are proposed by Mr. Boulenger in the present work, and only three of these are used for generic groups not previously recognised, the others being intended to replace terms that are inadmissible.

It is almost impossible to form an adequate opinion of the descriptions and synopses in a catalogue of this kind without testing them extensively, and the only thorough test is to try, by means of them, to identify unknown forms without having a series of specimens of allied species at hand. Most museum publications are deficient in this respect, because the writers do not make sufficient allowance for the difficulties under which those who have occasion to identify animals find themselves. An example or two may be taken from the present work. In the synopsis (p. 114) of *Hemidactylus,* one of the largest and most difficult genera of Geckoes, two groups of species are distinguished, the one by having the "free distal joints of all the digits remarkably short," the other by having them long. In a museum, with other species for comparison, this is a good distinction, but away from any specimens except the one that he is endeavouring to identify it is difficult for a naturalist to tell whether the joints of the lizard he is examining are remarkably short compared with those of other forms. Again, in *Draco* (p. 254) several species are distinguished by having the snout longer or shorter than the diameter of the orbit, but it is not stated how the snout is measured. It is but right to say that such instances appear exceptional in the present catalogue, and that it is very rare to find a work in zoology from which similar examples might not be taken.

One of the chief desiderata in books like the present is accuracy as to localities. The museum catalogues of a past age left much to be desired in this respect, and their shortcomings have had a pernicious influence on the progress of a study of wide biological and geological interest, that of the geographical distribution of animals. It will probably be a long time before all the erroneous localities are weeded out, but it is satisfactory to note the great improvement that has taken place in British Museum catalogues of late years. Where so much care has been expended on the subject as is shown in the present work, it appears almost ungracious to point to such trifling shortcomings as appear, though a few mistakes have naturally crept in. Thus the locality for *Acanthosaura (Oriocalotes) Kakhienensis* is not in the Khasia hills as stated at p. 305, but Ponsee, in the Kakhyen hills, on the borders of Yunan. Again, considering the extensive collections that have been made of late years throughout Bengal, it is very extraordinary, if *Hoplodactylus duvancelii* and *Gonyocephalus bellii* really occur in the province that neither of them has been rediscovered, and the locality should not be recorded without doubt.

Altogether the present volume quite maintains the level that the best recent museum catalogues have led naturalists to expect. Why it should be called a "second edition" is not clear. A comparison of the two editions resembles an antiquarian research. It is necessary to recall a state of zoological knowledge as extinct as the dodo before the conditions under which the so-called first edition was produced can be understood. When the head of the zoological department in the British Museum could propose to divide reptiles into two sections, one called *Squamata,* comprising the orders of lizards and snakes, and the other, called *Cataphracta,* consisting of tortoises, crocodiles, and amphisbænians, on the ground that the former were clad with scales and the latter with plates, the knowledge of the animals classified was evidently in a rudimentary stage. As if the classification

he description of the underground workings is scarcely ifficient to enable the reader to appreciate exactly the alue of the author's theoretical conclusions.

H. B.

## OUR BOOK SHELF

*en Norske Nordhavs-Expedition*, 1876 to 1878. XIII. Spongiadae. Ved G. Armauer Hansen. 25 pp., 7 plates, 1 map. (Christiania, 1885.)

HE thirteenth report on the zoological collections of the orwegian North Sea Expedition treats of the sponges, d is by one who, though well known as a student of her branches of zoology, has not, we fancy, been hither- known as a spongologist. We do not know whether e may not associate with this fact the somewhat alarm- g percentage of new species which he describes; of the rty-five enumerated, thirty, or two-thirds of the whole, e new; many of the species, among which it is interest- g to note there is a new Hyalonema, *H. arcticum*, are ry briefly described; on the other hand, the figures, as other parts of this report, are well executed, and will of considerable assistance in the detection of the cies by other workers. The author was, unfortunately, able to obtain any preparations in which he could e out the canal system, or the structure of the soft rts, and he has, therefore, confined himself to an ount of the spicules. With regard to these he has, are glad to note, made use of the stenographic system ich was invented by Dr. Vosmaer; any and every pro- ition for abbreviating the descriptions of species ought be tested, for the abundance of "literature" is a very eatening danger to science. It is not likely that all methods that have been from time to time suggested be found to be useful: no one, for example, has fol- ed the two methods proposed by the late Prof. Garrod, that adopted by Prof. Jeffrey Bell in the description of cies of starfishes; on the other hand, Dr. Herbert rpenter has taken up and improved the method sug- ed by Prof. Bell for the species of Comatulids, and , we understand, adopt it in his forthcoming *Challenger* ort. The chief objections to formulæ as applied ier to species, or spicules, or other organs, are, of rse, that a particular method has to be learned, and , if it is too brief, it tells us too little. The latter, for nple, is true of the Owenian method of formulating dental characters of Mammalia; it tells us that, while *nura* has eight premolars above and below, *Erinaceus* six above and four below, but it does not tell us which missing in the latter. If we desire to register our wledge on this point, we must make use of the more orate system devised by Prof. Flower and Dr. Dobson. the former objection, we must bear in mind that some les have had such names as floricomo-hexradiate, or nto-ternate, applied to them, and we can well imagine a formula may well be accepted as a not unpleasant native.

*Hunterian Oration.* Delivered at the Royal College Surgeons, by John Marshall, F.R.S., &c. (London: nith, Elder, and Co., 1885.)

only the wide range and perennial importance of work of John Hunter—the surgeon and anatomist n the clear judgment of Buckle places second only ristotle among inquirers into organic nature—but he fertility of human ingenuity, is shown by the fact for nearly a century, every year has seen some ent surgeon discourse with more or less variety and ness upon the life and achievements of this graet

e novelties of Mr. Marshall's treatment of the well- theme are, first, recounting the life of his hero wards in successive decennia from his grave to his cradle; and, secondly, bringing Hunter into the modern world of science, and imagining the way in which he would be affected by modern methods and modern results. No doubt he would be delighted to see the splendid collection which has grown out of his "Hunterian Museum," but whether he would be more pleased or puzzled by the technics of histology and the elaborate machines of a physiological laboratory may perhaps be doubted.

An orator must be an eulogist, and in this case there is ample room for praise; but it would be a valuable contribution to criticism if Mr. Marshall, or some equally qualified man, would discuss Hunter's achievements as an anatomist, compared with Meckel and Cuvier; as a surgeon, with his contemporary Pott, and his successors Astley Cooper and Brodie; as a physiologist with Haller and Bichat; and as a naturalist—on the broad ground which includes human and "comparative" anatomy, normal and morbid structure, "the physiology of disease" (to use Hunter's own phrase), as well as that of health—with the only successor he has had, or, we may predict, ever will have, the illustrious Johannes Müller.

To such a critic might be suggested as shades in the intellectual portrait, Hunter's neglect of the aid of magnifying glasses such as were used to good effect before him by Leewenhoeck and Grew; his want of learning and cultivation, with a certain consequent narrowness of mind; and such occasional obscurity of language as may not unfairly be taken to imply some obscurity of thought. "Definitions," he says, "of all things on the face of the earth are the most cursed." But may not the use of terms without definition sometimes excuse a choleric word?

After the most exacting criticism, there is no question that Hunter's name would remain one of the glories of this country—to be mentioned next to those of Harvey, Newton, and Darwin. It is therefore most fitting that his fame should be kept green by the annual piety of successive orators, and of these Mr. Marshall is a worthy compeer.

## 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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### Notes on the Action of the Wimshurst Induction Machine

AN interesting notice on the different influence-machines now in use occurs in NATURE, vol. xxviii. p. 12. Of these ingenious instruments, that lately devised by Mr. Wimshurst is likely to recommend itself beyond others, on account of the ease with which it may be excited, even in a damp atmosphere, and the high tension of the electricity discharged from its accumulators.

The following remarks lay no claim to originality, but they may nevertheless afford some interest to those who would witness its effects at a small pecuniary outlay; indeed its construction is well within the powers of the amateur mechanic.

Makers advertise sparks of fabulous length from comparatively small machines, but dense discharges of 4½ inches may be obtained under favourable circumstances from disks of 15 inches diameter, if care be taken adequately to insulate the collecting apparatus. It is obvious that an *unassisted* spark of 9 inches cannot be produced from plates whose minimum air-spaces of insulation do not exceed 3½ inches. The weakest part of insulation in these machines is usually between the metal inductors and the attachments of the driving-gear and spindle. In the dark, beautiful brushes of light flash across these spaces, and thus they point where the electricity leaks away from the accumulators. The tendency to form these brushes may be much diminished by cementing a small disk of sheet caoutchouc over the inner ends of each metal-inducing strap.

The machine in full work presents several points of interest, the explanation of which, perhaps, is not very obvious. The first I would notice is, that although 15-inch plates will scarcely give an *unassisted* spark of more than $1\frac{1}{2}$ inches in length, the interposition of a trifling condenser, showing only a coated surface of 6 square inches, will entirely change the character of this spark, the almost continuous stream of short sparks giving place to fewer, zigzag, snapping, 4-inch discharges, of much increased density and brilliance. The attachment of a condensing tube, constructed as follows, will be found a valuable addition to such machines as collect separately the positive and negative electricities.

About 18 inches of thin glass combustion-tubing of $\frac{3}{4}$-inch diameter is taken. Within, and at 4 inches distance from each end, a space of 2 inches is coated with tinfoil, leaving a space of 5 inches or so of clear glass between them. Two similar pieces of foil are fixed by a thin coat of gold-size on the exterior of this tube. They superpose the inner pieces of foil, and act as the outer coats of two small Leyden jars united as it were in one. These outer coatings are connected by a strip of tinfoil. The inner coats are placed in contact respectively with the plus and minus collectors of the machine, by means of thick brass wires thrust through caoutchouc plugs. The wires are so bent that their ends may drop into suitable holes, from which they may be at any time detached.

A thin coat of spirit lac-varnish spread within and without much favours the insulation of the tube.

Thus arranged, bright angular sparks of 4 or more inches in length will pass between the knobs of the discharger at *every three-quarter turns* of the handle.

Another point of interest offers itself when the knobs of the discharger are placed beyond their usual striking distance. In such a case the spark very frequently passes within the tube from coating to coating, quite silently, and with an optical illusion of comparative slowness of transit. When first I noticed these bright flashes of light, they suggested the form of an undulating fire-ball, and this brought to my remembrance the often-described but obscure phenomenon of "ball-lightning." I could not, however, detect any real retardation of the discharge by a somewhat rough experiment with the ordinary spark-wheel.

When two large jars are connected with the machine the disruptive discharge of 4 inches is accompanied by a sharp report, like that of a small pistol. I was not prepared for the fact that such a noisy discharge made to pass through the condensing-tube is quite silent, just as if it flashed through a partial vacuum. It may also be noted that the spark through the tube may be made much to exceed the length of the discharge in the ordinary way.

The last point I now mention, and concerning which I should value the remarks of Mr. Wimshurst, or any other competent electrician, is the increasing intensity of charge taken up by the metal inducers, or sectors, as they pass each other between the point of their contact with the earth through the metallic brush and the next following comb-collector. In the electrophorus such a contact is required once between the delivery of each spark; whereas in the machine here used, having perhaps twenty-eight sectors, a contact is given only once in seven inductive processes.

It will be found that well-varnished jars, without the usual wooden tops, are much the most efficient. Nevertheless, even these sometimes become so highly charged, that the electricity will force itself over their edges, doubling back, as it were, over a distance of 5 inches.

A pretty, but somewhat trifling experiment may be made by attaching two jars of unequal capacities to the collectors. Thus a jar of half a pint capacity placed on one side may be flanked by a quart jar on the other. Here the small jar, if the coatings be not too distant from the lip, will discharge itself three different times, whilst the large jar is getting sufficient tension to strike, say, at $3\frac{1}{2}$ inches. Both jars will then discharge together across the upper knobs. It may thus be shown that four half-pints of electricity make one quart of the same, as in liquid measure.

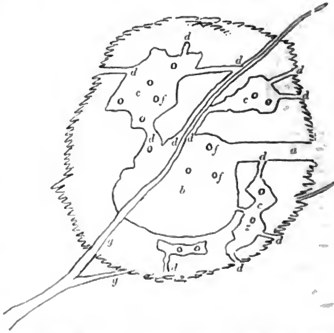
G. B. BUCKTON

## Nesting of Micropternus Phæoceps

IN continuation of the communication from my friend, Mr. Wm. Davison, regarding the nesting of woodpeckers in ants' nests, published in NATURE (vol. xxxi. p. 438), perhaps the follow[illegible] of mine may be of interest :—

*Camp Meplay, Thoung-yeen Valley, Tenasserim, April 20, 1882*

This morning, in going from my camp to the Meplay Forest Reserve, I had to pass through several densely overgrown phonzohs.[1] While making my way along with some difficulty, I startled a brown woodpecker (*Micropternus phæoceps*) from a small pyingado tree (*Xylia dolabriformis*). Looking up into the branches I saw a large ants' nest, in the centre of which appeared a circular hole so exactly like the borings made by woodpeckers ordinarily in the trunks of trees, that I sent up a Karen boy who was with me to ascertain whether it was possible the Micropternus had been boring into the ants' nest, as, I had heard was the bird's curious habit. The ants' nest was only about ten feet above the ground, placed in a fork of the pyingado, two small branches of which passed clean through it. Climbing up, putting in his fingers and then a twig, my Karen follower announced that there were two eggs. Leaving the nest alone for the time being, in the evening I returned by the same route, and was able not only to cut off and carry into camp the whole nest as it was; but I managed to secure also the hen bird as she flew from the eggs. Arrived in camp, I got the two eggs out, and then very carefully made a cross-section through the



*a*, entrance tunnel made by woodpecker; *b*, retort-shaped nesting-chamber of woodpecker; *c*, excavations made by the ants; *d d d* ...... *d*, entrances to them; *f f f* ...... *f*, tunnels made by the ants; *g g*, fork of pyingado branch—one twig passing through the egg-chamber excavated by the woodpecker.

ants' nest so as to divide the boring made by the woodpecker longitudinally.

The accompanying is a rough diagrammatic sketch of the appearance of the cross-section of the nest as hollowed out by the woodpeckers. The ants' nest was a large, spherical, solid mass of leaves and clay, the leaves outside being arranged one over the other something like the tiles on the roof of a house, but riddled in many places with the entrance tunnels made by the ants—a small black and red species of *Myrmica*, the trivial or specific name of which I do not know. It is probably closely allied to the *Myrmica* mentioned by Sir J. Lubbock in his "Ants, Bees, Wasps" as having been described by Sykes in the *Trans. Ent. Soc.*, vol. i. Very few of the ants

[1] The wild hill-tribes of Burmah and Tenasserim have a wasteful system of cultivation called "toung-yah." Yearly, in February, the heads of families in a village choose, each head for himself, a spot of well-grown, often virgin forest, generally on a hill-side, and within as convenient a distance of the village as is obtainable, cut down all the trees big and small, and allow them to dry during the hot months of March, April, and May, and towards the latter end of the last month set fire to them. The ashes thus obtained from the timber forms a splendid manure for paddy, and *toung-yah* rice is preferred by the Karens to ordinary *quin* (field) rice. The "toung-yah," or clearing after the paddy has been gathered in, is abandoned, and in two or three months, under a hot sun and excessive moisture, becomes an inaccessible jungle, full of thorny bamboos, creepers, and elephant grass. Such deserted *toungyahs* are called *phonzohs*, and are not again cultivable for from ten to fifteen years.

remained in the nest, and the few that were about seemed agitated and stung virulently. Probably the mass of them had been driven off or eaten by the woodpeckers. The tunnel the latter had made was about two inches in diameter and four inches long, bored horizontally in, and ending in an irregular-shaped egg-chamber about ten and a half inches in cross diameter, but narrowed by the branch of pyingado which pierced the nest through and through, and crossed the egg-chamber diagonally. The bottom of this chamber alone was smooth, but there was no lining, and the two translucent white eggs of the woodpecker had rested on the bare boards, so to speak, of the ants' house. In the excavations *c c c* made by the ants themselves there were neither eggs, larvæ, nor pupæ; probably these all had been removed when the woodpeckers invaded the nest.

CHARLES BINGHAM,
Deputy Conservator of Forests, British Burmah
Henzada, British Burmah, April 12

### Staminody of Petals

The cases of staminody of petals not being very frequent, it may be of interest to draw the attention of the readers of NATURE to such a modification as observed in Fuchsia.

The places of the four petals of the flower examined are occupied by four almost colourless filaments of an average length of three-fifths of an inch. Each of them bears on its top a nearly circular dark red lamina of three-tenths of an inch diameter. These laminæ are so strongly vaulted as to have the shape of a segment of a globe, the hollow side being turned outward, the convex inward. At the base of the lamina, *i.e.* at the top of the filament, a short protuberance is seen, resembling in external shape the lower part of an anther. This anther occupies the concave side of the lamina and is consequently turned outward. Though the anther of one of the petals is only slightly developed, yet it may be admitted as a matter of fact that, instead of petals, this flower has produced four stamens, whose anthers bear a petaloid appendage. A microscopic examination, namely, showed not only the peculiar composition of the anther-wall, but also the presence of pollen-grains.

Of the stamens, properly so called, the outer whorl is present, but the inner one is only represented by two of the four. One of these two is inserted in the ordinary way, viz. at the base of the petal. The second, however, has grown together half way up with the petal's filament; there it has, in consequence of a spiral turning, arrived at the back side of the petal, whence it bends obliquely outward. By this union the impression is created of a stamen rising from the back of the (modified) petal, concealing its anther in the lamina's concavity. This occurrence brings to recollection the case of *Monarda fistulosa* as cited by Maxwell T. Masters from Turpin ("Vegetable Teratology," p. 298), with this difference, however, that what is probably only adhesion is mistaken for petalody, whilst the case above described offers an antheroid petal grown together with a true stamen.

J. C. COSTERUS
Amsterdam, May 4

### Catalogue of Fossil Mammalia in the British Museum, Part I.

IN the review of the above work in a late number of NATURE (vol. xxxi. p. 597) the reviewer entertains such a complete misapprehension of my system of naming the premolar teeth of typical heterodont Eutherian mammals that I must beg space to correct it.

The reviewer asserts that this system is untrue because it implies that in general with a smaller number than the full complement of four premolars the diminution must have commenced with the first, proceeded with the second, and so on. In reality it implies nothing of the kind, and if he had taken the trouble to turn to pp. 152 (No. 39,732) and 174 (No. 48,787) he would have seen instances where I have mentioned the absence of the middle teeth (*pm.*2 and *pm.*3) and the retention of the terminal teeth (*pm.*1 and *pm.*4). Similarly in the "Palæontologia Indica," ser. 10, vol. iii. p. 48, I have adopted the same system for the incisors, and have shown that in *Hippopotamus* it is *i.*2, and not *i.*3, that disappears in some species.

I am well aware that in many of the Insectivora and Chiroptera there is often great difficulty in deciding on the homology of the individual premolars when these are reduced in number; and the reviewer might have noticed that in the former order I have not ventured to definitely determine the position of any tooth in advance of the last premolar. Among the Chiroptera I have considered the three premolars of *Vespertilio* (p. 13) as homologous with the last three of the typical series, as there is apparently no evidence to the contary; the small size of *pm.* 3 indicates, however, that an allied genus may retain only *pm.* 2 and *pm.* 4; but the minute size of the one tooth in advance of *pm.* 4 in *Rhinolophus* has induced me to regard it as *pm.* 3, although it may be *pm.* 2.

The advantage of the system employed in the "Catalogue" is well instanced when we contrast the premolar dentition of *Canis*, and *Lepus* or *Theridomys*; the homology of the last tooth of this series (and there is only one in *Theridomys*) being at once seen, whereas it is entirely lost if we employ a method like that used in Dr. Dobson's "Catalogue of Chiroptera," where the actual first tooth in each genus is called the first of the series. I claim for the system adopted by myself every advantage in those cases where it is possible to determine the homology of the individual premolars in any form in which the number does not exceed four; and even in cases where such determination is not absolutely certain, the error can be but very slight, and does not lead to the utter confusion caused by the system (or, rather, the want of system) which I presume the reviewer would prefer.

When we come to those mammals in which the number of premolars is more than four, my syste n fails; and, in view of this, some German writers have adopted the plan of numbering the premolars the reverse way—*i.e.* terming the premolar next the first molar *pm.* 1, and then counting towards the incisors. Although this system would be advantageous if we could always be sure of the division between the premolars and molars in homœodont mammals; yet it has several disadvantages, and has not, therefore, been adopted.

In reference to the suggestion of your reviewer, that instead of making a catalogue of the fossil Mammalia in the collection of the British Museum (as I was instructed to do by the Museum Authorities), I should have made one of all the known species of fossil Mammalia, any person having the slightest pretence to any knowledge of the present state of mammalian palæontology would have at once known that it would be utterly useless to attempt any such work at the present time, when new species and genera are being made almost daily, and a host of those already made are as yet but empty names.

As a minor matter, I may mention in regard to the lower jaws of *Crossopus*, alluded to in the review, that their identification rests solely on the authority of Prof. Sir R. Owen, and that perhaps I have acted in a too conservative spirit in admitting them.

Harpenden Lodge, May 2 RICHARD LYDEKKER

### Fossil Insects

"THE Earliest Winged Insects of America; a Re-examination of the Devonian Insects of New Brunswick in the Light of Criticisms and of New Studies of other Palæozoic Types," is the title of a *brochure* by Mr. S. H. Scudder, of Cambridge, Mass., recently published.

These Devonian insects are fragments of five wings; a sixth is now dropped, as "too imperfect for any satisfactory discussion," though in 1881 its description filled about two quarto pages. These insects have been, since 1865, so often discussed that their literature is a rather voluminous one. A number of far-reaching conclusions elaborated by the author would have to be abandoned if the determination of the insects should be proved incorrect. This I endeavoured to do in *Bull. Mus. Comp. Zool.*, viii. No. 14, Cambridge, 1881, and in NATURE, xxiii p. 483. The principal aim of the author's new paper is to show that my determinations are erroneous. Concerning his statement that I have studied in nature only the (in most cases poorer) reverses, I may remark that his paper gives nothing more, after his study of the obver-es; even less for Gerephemera.

These Devonian insects have been decidedly unfortunate from the very outset. Eminent palæontologists denied their Devonian origin, and put them to the Carboniferous or to the "Ursa Stufe" of the sub-Carboniferous. One of the insects, *Xenoneura antiquorum*, said to possess a stridulating organ on the wing, caused an unusual sensation. Poetic palæontologists were delighted to be introduced by this insect to the sounds of the Devonian woods. Now these woods are silent again, except in some text-books. "It does not appear reasonable," said the author, "to maintain my former hypothesis of a stridulating organ." Everybody acquainted with such organs will be of his opinion.

Another insect, *Homothetus fossilis*, was said to have a small basal vein, considered to be homologous with the arculus of the Odonata, and therefore to form a connecting link between Neuroptera and Pseudoneuroptera. A new synthetic family, Homothetidæ, was proposed. But now a re-examination of this wing convinces the author "that he had been mistaken about this arculus." It does not exist at all.

The third insect, *Platephemera antiqua*, was determined by me as the apical half of the wing of a gigantic dragon-fly. As this is the only species claimed now by the author to belong to the Ephemeridæ, he defends vigorously his determination by four objections:—(1) "In no dragon-fly, living or fossil, is there found beyond the nodus between the mediana and margin, more than a simple longitudinal vein, the marginal vein." If the author will examine any Odonate wing *from below*, he will find such a vein, which is the prolongation of the subcosta, bent on the nodus to the marginal vein, and running close to it. Near the nodus it is more widely separated in larger species. (2) "The reconstruction of the wing, after the dimensions given by Dr. Hagen, would, on the most favourable showing, make a wing of ridiculously extravagant appearance." But such forms occur in living species of Tramea, Rhyothemis, &c." (3) "The narrowing of the second cubital space is a common feature in Ephemeridæ (six genera after the Rev. Mr. Eaton's plates are quoted); and, as this varies in different species of the same genus, it seems to be a very unimportant matter." I had purposely stated *suddenly narrowing*, and *this* does not exist at all in Ephemeridæ, namely *not in the six quoted* genera, and cannot therefore vary in the different species of the same genus. It exists in Odonata. (4) "The sector subnodalis does not run unbroken to the tip, as in all dragon-flies I have examined, but is lost in reticulation shortly before the margin." This last-quoted character is a very common feature in dragon-flies (Tramea, Rhyothemis, &c.). Only *very exceptionally* this sector runs unbroken to the tip in the large sub-family of Æschnidæ (*cf.* De Selys's "Revue des Odonates d'Europe," p. 122).

As all objections have been proved *to be incorrect*, and only based upon insufficient knowledge of the venation of Odonata and Ephemeridæ, Platephemera belongs by the simple evidence of facts to the Odonata. The new proposed family of Palephemeridæ dies unborn, and the conclusions made from Palephemera are without value.

The fourth species, Gerephemera, gives much trouble to the author, and he is now inclined to bring it into the same group with the Protophasmida. As only a part about 4 mm. broad can be said to exist in both figures (Brongniart and Scudder) which could be compared, and as this part contains only a few sectors running to the margin, the relationship of Protophasma to Gerephemera is not at all obvious. The reverse of Gerephemera contains more than the author has seen. The basal part of a hind wing to the sector trigonali inferior, the basal part of a front wing with the same sector, and some veins belonging, probably, to another (front?) wing. The part figured and described by the author belongs, probably, to the other hind wing. No student of Odonata will be in doubt that Gerephemera belongs to this family, perhaps near Isophlebia. His statement "that the superior origin of the branches of the sector medius is entirely inconsistent with an Odonate hypothesis, and is the most salient point in the wing," is directly recognised as an error by looking at the figures in De Selys's "Monograph Calopterygines" (*cf.* Cleis, Vestalis, Neurobasis, &c.). This statement is only surpassed by the emphatic repetition "that the marginal would then be an elevated, and the mediastinal a depressed, vein, *which combination is never the case.*" This statement is just the contrary to what exists in all Odonata—unless it is preferred to examine the wings from beneath.

There exists still no monograph of the Sialidæ; therefore it is impossible to make conclusions and form new families for the other three Devonian species. The opinion on the Devonian insects given by Rev. A. E. Eaton (NATURE, vol. xxiii. p. 507) is still very just: "Palæontologists have adopted a ridiculous course with regard to some insect fossils. Whenever an obscure fragment of a well-reticulated insect-wing is found in a rock, a genus is straightway set up, and the fossil named as a new species. The species is then referred to the Ephemeridæ, and is immediately pronounced to be a synthetic type of insects at present dis[illegible]related to one another in organisation. This enuncia[illegible]tic types is often nothing less than a resort at random conjecture respecting the affinities of animals which the writer is at loss to classify. I thought that the Ephemeridæ had served quite long enough as an asylum for fossil cripples. I wished to intimate gently, that refuse of other groups of insects should be henceforth shot elsewhere."

Cambridge, Mass., March 12 H. A. HAGEN

## High-Level Stations

IN NATURE, vol. xxxii. p. 17, I find the abstract of an address by Mr. Omond, on "Ben Nevis." There are many points of interest, but I regret that one was not mentioned—viz. the exceedingly rapid decrease of temperature with elevation from Fort William to the Ben, anything nearly approaching, in middle latitudes, being only found on the Brocken, and all high-level stations of the Alps showing a much smaller decrease. At the Brocken, as well as at the Ben, the great difference from the Alps is not in summer, but in the colder months of the year. The reason seems to lie in the nearly constant winds, which bring air from below, which is cooled by ascension. The cases of great dryness of the air with descending currents in anticyclones in the colder months of the year, when isolated mountains are often much warmer than the valleys,[1] are comparatively rare in the North of Scotland, but frequent in the Alps, and certainly must and do have a great influence on the mean temperature. Where they are frequent, as in the Alps—especially the eastern—the mean amount of decrease of temperature with elevation must be slower.

I think all meteorologists will concur with me that the greatest points of interest in the Ben Nevis station is the study of the meteorological phenomena near the centres of cyclones, as no high-level station in the world is so favourably situated as this for this study. A. WOEIKOF

St. Petersburg, May 1 (13)

## Rainbow Phenomena

YOUR correspondent Mr. C. Croft (NATURE, No. 811, p. 30) has noticed phenomena which are perfectly familiar to students of physical optics. The internal bands of colour within the primary bow are the "supernumerary" bows due to diffraction. They were described by Langwith in the *Philosophical Transactions* for 1722: a partial theory of them was given by Young in 1804, and a complete theory by Sir G. Airy in 1836. The illumination of the sky in the regions within the primary and without the secondary bows, and also the relative darkness of the space between the two bows, Mr. Croft will find the desired explanation in any elementary treatise on optics; Osmund Airy's Geometrical Optics may be cited as giving a good account of these matters. The particular bow seen by Mr. Croft appears to have been of unusual brilliancy; did he notice any of the radial streaks, which I described in 1878 as frequently accompanying rainbows? SILVANUS P. THOMPSON

Finsbury Technical College, May 16

## Aurora

LAST night at about 10.30 to 10.35 p.m. there was a well-marked aurora visible from here. It did not last long, the bright bands fading rapidly into a general glow towards the north. The wind, which was easterly yesterday, has gone round to north-west to-day with tendency to rain and low temperature. J. P. O'REILLY

Royal College of Science for Ireland, Stephen's Green, Dublin, May 14

## Red Hail

MR. W. H. MITCHEL, of Newry, has sent me the accompanying note, which he thinks may be of interest to the readers of NATURE. C. EVANS

Downshire Hill, Hampstead, N.W., May 18

On May 7, Mr. R. A. Mullan, solicitor, of Newry, was driving in a gig near Castlewellan, co. Down, when he was overtaken by a shower of hail. To his surprise he observed that some of the hail-stones—perhaps one in a hundred—were of a

[1] This is well explained in the "Handbuch der Climatologie" of T. Hann. See also my paper in the *Zeitschr. f. Meteorologie*, 1885, pp. 211, 241.

decided red colour, the rest being white, as usual. Taking up some that fell in the gig, Mr. Mullan found that the colour was not merely superficial, but pervaded the substance of the hailstone, and, on melting, they stained the fingers. He did not think, or had not the means, of preserving any of the water resulting. Has the like been observed before?

### Spectral Images

MR. BIDWELL'S notice of spectral images (NATURE, vol. xxxii. p. 30) calls to mind certain phenomena I witnessed while riding in a railway train in Kentucky last October. The fence of the railway consisted of posts of about 6 inches in diameter, and twenty paces apart, connected by wires. The posts had newly been painted green. I was seated on the right side of the carriage, face forwards; the speed fully twenty miles an hour, with the sun behind my right shoulder, when looking at the posts on the left side, brightly illuminated by the sun, I observed that each post had the appearance of a twin post immediately in advance of it—touching it—of a red colour. To make myself sure that I was not deceived by some abnormal affection, I called the attention of a niece of mine to the phenomenon, and she saw it quite as well as I did. Another niece, however, failed to make it out. I am under the belief that the red post was the complementary colour of the green one, appearing the instant after the latter had been seen, and though apparently in advance in space of the green post, really was seen later in time. The fact of both being apparently seen simultaneously, is accounted for by the well-known law of retinal images lingering on vision. HENRY MUIRHEAD

Cambuslang

## *THE NEW OUTBURST OF LAVA FROM VESUVIUS*

YESTERDAY, May 2, up to two o'clock, Vesuvius appeared to be in its natural state of activity, such as persisted with slight variations for some considerable time. At that hour the lava, which was at some height within the cone of eruption, forced a way out at its base, traversing the plain of old lava filling the crater of 1872, and producing a rent about one quarter the way down the great Vesuvian cone. This rent represents the extension outwards of a volcanic dyke that has been in process of formation for over two years. A visitor during that period who walked around the southern rim of the 1872 crater, might have noticed a fissure varying from a few inches up to 2 feet wide, and extending inwards across the crater plain, until lost beneath the *ejectamenta* of the cone of eruption. From this fissure issued a powerful current of hot air, and in part of its course an abundance of HCl. This latter was indicated by the continual decomposition of the scoria and ash in its immediate neighbourhood, so that a large patch of yellow dust filled with the unattached pyroxene crystals was a point of bright colour in the black scoria-covered lava-plain. The lava at first actually issued, or, more properly, welled up from this fissure, but its point of exit was soon lowered by the cutting down of the outer slope. The lava soon commenced to flow down the cone with considerable rapidity, forming two distinct parallel streams averaging fifty metres apart, so that in the evening the landscape was lit up by these two brilliant streaks of fire. This morning I started early, and ascended on foot to the eastern side of the two streams, though often inconvenienced by the hot wind and exhalations blown off the lava. The streams take origin close together, and no doubt conjoin, but are covered by scoria—a vast quantity of *lapillo* and ash that has been slipped downwards and forward, forming a rough annular space which would require a drawing to explain. At the upper end of this we have part of the great cone slipped down, showing in section the dyke, which I may call hollow; we have a fissure which was filled by lava, and which consolidated and adhered to its sides, forming *salbam*; but before the central part solidified, the general level was lowered, and it drained away, leaving the dyke divided in two by an empty space At 2 p.m. to day the streams of lava had the following dimensions at their exit:—

| | Eastern | | Western |
|---|---|---|---|
| Breadth | about $1\frac{1}{2}$ metres | ... | About $2\frac{1}{2}$ metres |
| Depth | estimated at 1 metre | ... | at 2 metres |

Rate of flow on both, about 1 metre per second.

The output therefore equals for the eastern stream about 90 cubic metres per hour, or 2160 cubic metres in 24 hours, whilst that of the western stream represents 300 cubic metres per hour, or 7200 in 24 hours. The two streams, therefore, represent an output of 9360 cubic metres during the 24 hours, from May 2 to 3, at 2 p.m. This quantity would equal a deposit of rock of about 1 km. long, 9 m. broad, and 1 m. thick, which is rather an under-estimation of what now lies on the side of the mountain, for the two streams had at the hour of observation traversed more than two-thirds of the *pedimenture*. The amount of lava represents far more than what occupied the chimney above the level of the lateral opening, and the mechanism of the increased quantity extruded I have gone into fully in a paper read last week before the Geological Society. The cone of eruption only now gives forth vapour, its stone-throwing propensities being stopped by the lowering of the magma level. In consequence of the want of support of its inner walls by disappearance of the fluid column, these are rapidly crumbling in, and the craterial inner cavity much increased in size. In the same way a breach has been made in the line of the dyke by falling in of that part of loose materials immediately above it.

This change in Vesuvius will no doubt be put down in history as an eruption, and possibly a relationship sought between contemporaneous earthquakes, or some other phenomena. It is nothing more nor less than the final giving way of part of the cone before a dyke that has been working its way out for years.

I send you these few notes after a long day's climb, exposed to great changes of temperature and mephitic vapours. I ask, therefore, that this will be taken as an excuse for these rough and ready notes, which I thought your readers would be interested to have quickly.

Naples, May 3 H. J. JOHNSTON-LAVIS

## *EXPERIMENTS WITH COAL-DUST AT NEUNKIRCHEN, IN GERMANY*

IN a former article on this subject which appeared in NATURE of Nov. 6 last (p. 12), I described the apparatus employed by the Prussian Firedamp Commission in making their experiments, and at the same time I gave an account of four experiments that were seen by Mr. Wm. Thomas Lewis and myself.

No official account of these experiments had been published at that time, but quite recently Herr Hilt and Herr Margraf have made a joint report in the name of the Commission. As this report is intended to be only a preliminary one, it does not give the whole of the details of each experiment, but it shows as far as it goes that everything has been conceived and carried out in a spirit of liberality and thoroughness.

At the outset Herr Hilt states that the uncertainty which seemed to surround this important question, and in particular the peculiar views that had been enunciated by MM. Mallard and Le Chatelier, who reported upon it to the French Commission du Grisou,[1] had induced him to address a letter on the subject, dated December 15, 1883, to the Prussian Wetter-Commission, urging them as a matter of duty to take it up and investigate it by a series of large-scale experiments. The French Commissioners, referred to, stated at the end of their report that "they considered it established that coal-dust in the absence of fire-damp does not constitute an element

[1] *Annales des Mines*, Janvier—Février, 1882.

danger." "It may, however, play an important part in aggravating the consequences of a firedamp explosion." I had myself keenly felt how difficult it would be after a verdict of this kind, emanating from such high authorities, to make further progress in the work of convincing practical mining men of the truth of the views I had previously advocated in the pages of the Royal Society's *Proceedings*. For that reason, and in the absence of some powerful weapon wherewith to meet the French Commissioners with some chance of success, I have hitherto desisted from doing battle with them, although I have been satisfied they were in error from the first. The required weapon has been provided by Herr Hilt, the spokesman of the Prussian Commission, and may now, I think, be made use of without much fear of future contradiction.

Speaking of coal-dust from Pluto Mine, in Westphalia, Herr Hilt says, as the outcome of a long series of practical experiments on the largest scale yet attempted: "Es kann keinem Zweifel unterliegen dass mann mit dieser Staubsorte bei Verlangerung der Strecke und Streuung auch der Flamme eine beliebige Länge würde-gebenkönnen. Ganz ahnlich erhalt sich der Staub von Neu Iserlohn." Or: "There can be no doubt that with this kind of dust the flame could be lengthened out to any desired extent, provided the gallery and the layer of dust on its floor were made equally long." "The dust of Neu Iserlohn behaves in exactly the same way."[1]

After carefully examining the details of this report, I think it not improbable that many, if not most, of the other twenty-four kinds of coal-dust that were subjected to experiment would have given results similar to those which led to the foregoing remarks had they been employed in the same state of minute subdivision. Differences in chemical composition do not appear to have as much effect in controlling the length of flame produced by a given dust under a certain set of conditions as the comparative fineness of the particles of which it is composed. In order to show the effect of fineness Herr Margraf has divided the dusts into five classes, as follows:—

| Number of Dusts in each Class. | Designation of Class. | Length of Flame produced by firing 250 grm. of powder in cannon next floor, the floor being strewn with coal-dust for a length of 10 m. |
|---|---|---|
| Five, beginning with Pluto | Very fine ... | 21 to 31 m. |
| Twelve, ending with Camphausen ... ... ... ... | Fine ... ... | 13 to 21 m. |
| Four ... ... ... ... ... | Medium ... | 12 to 15 m. |
| Five ... ... ... ... ... | Coarse ... ... | 6 to 12 m. |

Some experiments were also made with dust passed through sieves having meshes of various widths, which showed that the finer the state of subdivision, the longer was the corresponding flame.

From this it is obvious that before anything definite can be ascertained regarding the influence of chemical composition, it will be necessary to reduce the dusts to a uniform standard of fineness. Herr Margraf proposes to do this by passing them through a sieve with meshes 1 mm. wide. I am afraid, however, that some more exact method of effecting a separation of the very fine from the moderately fine particles will have to be resorted to before a satisfactory result can be looked for. A current of air ascending slowly at a uniform rate would be a better means than any conceivable kind of sieve.

I have on several previous occasions pointed out that when a colliery explosion has been begun in a dry mine the coarser particles of coal-dust are winnowed from the finer ones by the blast of air which sweeps through the workings in advance of the flame. It seems to me that under these circumstances experiments made with any other than the finest particles of each kind of dust can serve no practicable purpose whatever, and that any general conclusions drawn from them must necessarily be misleading. It is further highly probable that this is the rock upon which the French Commission was shipwrecked.

They had ascertained by actual experiment that, as the coarser particles of any given dust were removed by sifting, the flame produced under the same set of conditions became longer and larger in proportion to the fineness of the remaining dust. Yet they failed to carry the argument to its legitimate conclusion. They appear to have been misled either by too much speculation, or by the negative results of their experiments, due, it may be, to the smallness of the scale upon which they were made. They finally pronounced coal-dust to be an element of very secondary importance in colliery explosions, thereby allowing a splendid opportunity to slip from their grasp. The Prussian Commissioners were not slow to take advantage of the opening thus afforded them. Thanks partly to the large scale upon which they have set to work, partly to the natural fineness of Pluto and Neu Iserlohn dust, they have been fortunate in obtaining a series of positive results which amply confirm those previously obtained with the somewhat smaller apparatus belonging to the Lords of Committee of Council on Education set up in this country under the auspices of the Royal Society (No. IV. paper, "On the Influence of Coal-dust in Colliery Explosions," *Proc. Roy. Soc.*, 1881).

The dust brought from Camphausen Colliery does not appear to stand very high on Herr Margraf's list, and yet, since the publication of the memoir, that colliery has been devastated by one of the most violent explosions on record, in which it is admitted, I believe, that coal-dust, and not fire-damp, was the principal agent of destruction. Are we to conclude from this that the nine dusts which lie between Pluto and Camphausen in the order of relative danger are equally liable to produce a flame of indefinite length under like favourable conditions? and, if so, is it not obvious that the experiments are not as reliable as might be wished, since they fail to tell us so?

Before concluding, I might mention that Herr Hilt refers to and agrees with a remark made by MM. Mallard and Le Chatelier to the effect that the method of experiment followed by Sir Frederick Abel and myself when using the apparatus described in my first paper was "too little exact" to determine accurately what percentage of gas is required to render a mixture of coal-dust and air inflammable. My earliest experiments here referred to were made with the view of finding, if possible, some rational explanation of great colliery explosions which up to that time appear to have baffled every attempt to grapple with them, and were not intended to form a kind of counterpart on the large scale of the exact eudiometric processes resorted to in the laboratory. At the same time I may state, however, that, so far as I have been able to ascertain by reading and observation, the methods then employed will compare not unfavourably, as regards exactness, with any that have succeeded them, not excluding those of the Prussian Wetter-Commission.

W. GALLOWAY

[1] It may be instructive to compare this conclusion with the second sentence of No. 3 paper, "On the Influence of Coal-dust in Colliery Explosions," *Proc. Roy. Soc.*, 1876, the second last sentence of No. 2 paper, *ibid.*, conclusion of No. 4 paper, *ibid.*, 1881.—(Abstract).

## THE FAUNA OF RUSSIAN CENTRAL ASIA

UNTIL within the last thirty years Turkistan has been unknown to science, and what is now ascertained concerning its fauna and flora is for the most part inaccessible to the scientific world because written in Russian. Not that autoptic writers of eminence upon the zoology of the country are numerous. They do not number a dozen, the names most conspicuous being Prjevalsky, Alpheraky, Bogdanoff, Severtsoff, and especially Fedchenko. Prjevalsky's routes do not touch mine, except in the Kuldja region, where also Alpheraky travelled, and collected Lepidoptera, with a list of which he has favoured me. To Bogdanoff and Severtsoff I am indebted for information not previously published in English, whilst in connection with the immense work that bears Fedchenko's name I have had the valuable help of Madame Olga Fedchenko, who both accompanied her husband on his scientific journeys and, after his lamented death, edited his works. When I add that I have before me proofs of between three and four thousand species of fauna and flora, in about twenty lists with introductions, the scientific reader will not need to be told that in the compass of a single article I can but touch the fringe of the subject. I have ventured to think, however, the readers of NATURE might be interested in a plain statement that would give some idea of the little-known fauna of Turkistan, as well as indicate what I hope to publish shortly in fuller form.

The part of Russian Central Asia through which I recently travelled, and with which this paper will be mainly concerned, lies between the Oxus and Irtish Rivers, and between the 38th and 50th parallels of north latitude, which region comprises vertically all altitudes from the salt plains, 600 feet above the sea, to the mountain plateaus of the Pamir, 15,000 feet high.

The species of mammals in Turkistan exceed 80 in number. Among them may be mentioned 7 species of bats, the long-eared hedgehog, and the white-clawed bear. To these must be added the badger, otter, and other *Mustelidæ*, including three species of marten. Of the last I was able to secure some skins and skeletons, which are now in the British Museum. The wolf abounds; also a wild dog; 3 species of fox; the tiger, snow-leopard, cheetah, and other cats. The salt-plains are frequented by the souslik, and many other rodents, including the hairy-nosed porcupine. To these should be added the Persian gazelle, the Saiga antilope, the Siberian ibex, and the Maral stag. I saw at Kuldja and Tashkend specimens of the skull and horns of the Thian Shan sheep, which is bigger than a donkey. The horn is more than four times the length of the skull, and the head complete weighs upwards of 70 lbs. The yak is kept by the Kara-Kirghese. The Russians, too, as an experiment, have introduced some cross-breeds into the plains.

The birds of Turkistan number nearly 400 species, to which may be added 27 frequenting the Pamir. The diurnal birds of prey, such as vultures, eagles, hawks, &c., number 36 species, some of which the Kirghese train for hunting. Of nocturnal birds of prey there are 9 species of owls. There are thirteen species of crows, and no less than 40 of the finch family, including a new species of sparrow. The thrush family is represented by the blackbird, black-throated, misletoe, and some other thrushes. There are more than 40 of the warbler family, many of them being known in Western Europe, such as the greater nightingale, the bluethroat, redstart, redbreast, and others. Six species of the titmouse family are found in Turkistan, only one of which, however, the well-known oxeye, is common also to England. Two species of dipper are found throughout the country, and other small birds are the Nepalese and European wrens, the Syrian nuthatch, and no less than 10 forms of wag-tails. Of pipits there are 7 species, and 14 of larks. The hoopoe I saw when coming south from Sergiopol, and again in the streets of Vierny. Other Turkistan birds are the bee-eaters, the three-toed woodpecker, the ubiquitous cuckoo, and the wonderful Pallas's sand-grouse, which last, some twenty years ago, invaded Europe in such an astonishing way.

Among gallinaceous or game birds are found in Turkistan the black grouse, the capercailie, four species of partridge, the quail, Mongolian pheasant, pea-fowl, and common cock. Of the swan, goose, and duck tribes there are nearly 30 species. Wading-birds, again, are found in great variety, and among them a red-billed curlew, thought at first to be a new species. It has red legs, and a remarkably long red beak, bent at the end, and well adapted for picking up worms from between the pebbles of the beds of the mountain streams it frequents.

Reptiles are represented in Turkistan by 33 species of lizards, vipers, and tortoises. Of the last I tried to bring for the Zoological Gardens a species (*Homopus horsfieldi*), and it travelled asleep with me some hundreds of miles from Tashkend, but on approaching Odessa it was found to be the sleep of death. Almost all the serpents are non-venomous. Of amphibians there are five species, including the edible frog and green toad.

The fishes of Turkistan are composed half of European and half of Asiatic forms. The European forms belong principally to the lower course of the Syr-daria, Amu-daria, and part of the Zarafshan, whilst certain genera belong exclusively, so far as is known, to the high mountainous countries of Central Asia. The total number of Turkistan species probably exceeds fifty. Of these twenty-five at least belong to the carp family, and there are taken besides sturgeon, trout, pike, barbels, gudgeon, rudd, roach, bleak, bream, loaches, and perch. The fishes of the Zarafshan are particularly noticeable. Of fifteen species found therein not less than five belong to genera met with in numbers in Kabul, Kashmir, Nepal, and the Himalayas. To one of these genera belongs the *Marinka*, remarkable for its poisonous eggs. The greatest find, however, among the ichthyological fauna of Turkistan has been the *Scaphirhynchus*, of great importance, not only from a zoological, but also a biological point of view, on account of the extreme smallness of its eyes and the rudimentary condition of its air bladder. This fish, and certain geological questions connected therewith, was referred to in NATURE in connection with a letter on the Oxus that appeared in the *Times* on January 7 last.

If for Mollusca we enlarge our area to take in Kashgar and Ladak, then we have in "Central Asia" thus formed 93 species known up to the present time, the land snails being scarce in the desert plains as compared with the larger number and more peculiar forms in the mountain regions. Among the fresh-water Mollusca the predominant feature is the large number of air-breathing species which live in stagnant water, and the almost total absence of the genera living in running water. It has been suggested that this scarcity may be due, as in Switzerland, to the low temperature and stony bed of the rivers.

Among the 50 species of Crustacea known in Turkistan there was not discovered for a long time a crayfish; but Madame Fedchenko informs me that one of a variety new to the species hitherto known in Russia has been recently found. Among the Crustacea inhabiting the fresh waters of Russian Central Asia a very large number of West European species is found, and the new species are, in the majority of instances, very similar to the commonest in Central and Southern Europe.

Of the 16 families to which European spiders are said to belong, all, except two groups very limited in number, have their representatives in Turkistan. The 146 species known there belong to 55 genera, which constitute approximately one-half of the total of European genera. The *Tarantulæ* are remarkable in that there are found in the Zarafshan Valley forms which in Europe are met with in countries far apart from each other, and have been reckoned as different species. The most widely distributed form is that with the lower part of the abdomen quite black; next comes the form with coloured edg and, finally, that with the lower part almost en' orange. The scorpions of Turkistan are identica those met with in Trans-Caucasia, and the distribut one species (*Solpuga intrepida*) is remarkable. found in Spain, it was seen later on the Indersk I tains, then in the Zarafshan Valley, besides which mens of this harvestman have been found in V

The animal is reckoned poisonous, and its bite has in certain cases been followed by death, although nothing is yet known of its poison-apparatus.

The species of Turkistan beetles are estimated at 1000. I have before me a list of 500, some of them as yet unpublished. Amongst the most remarkable is the *Copris tumulus*, the largest specimen measuring one inch and three-quarters long.

The hymenopterous fauna of Turkistan is not yet fully worked out, but I may observe that of *Mellifera* there are known 438 species, and of *Sphegidæ* upwards of 150. As regards the latter, the valleys of Ferghana and the Zarafshan do not present many specialities. On the other hand, the Kizil Kum desert abounds in new species and even genera, sharply distinguished from known species both in the form of the body and in the beauty and size of the individuals. There is, moreover, a remarkable similarity between the species belonging to the Kizil Kum and the Egyptian sands. Of *Scoliidæ* 30 species are known, whilst of *Mutillidæ* 18 species have been treated by Gen. Radoszkovsky, who informs me that Gen. Komaroff, now military governor of the Trans-Caspian district, has quite recently made scientific explorations between Askhabad and Merv, and that among the insects collected by him about Askhabad are six species of *Mutillidæ*, four of which are marked as new, and one as a new genus. Of 36 species of ants collected in Turkistan, 7 only were new. The Formicidæ of the region seem to be very similar to those of South Europe. This is not astonishing, since the mean temperature of a Turkistan summer differs little from the mean summer heat in Southern Europe, and this case only proves once more that, in general, countries with summers alike have greater similarity with regard to fauna and flora than countries lying under identical isotherms with different summers. This peculiarity is evident with regard to Formicidæ, because, for example, in Italy and Turkistan they have an identical summer; and though the winter in Turkistan is long and cold, it does not appear to have much influence over the ants, which are protected therefrom. European species which live in trees and woods appear to be in most cases absent from Turkistan. Of the new Turkistan species one *Ichneumon* [illegible]*cephs*, is specially interesting, as closely allied to two species inhabiting countries between the tropical and subtropical zones of the southern hemisphere. It is remarkable, therefore, to meet with a species of the same genus in the temperate zone of the northern hemisphere, and it may be presumed that these last have existed in Turkistan since the Tertiary period. I have yet to mention *Chrysidiformes*, of which 53 species have been found in Turkistan, and among them 2 new genera and 15 new species.

Before passing from hymenopterous insects I may mention that, though saw-flies are not numerous in the Zarafshan Valley, yet there is one form particularly remarkable, for, with a normal male, related to the group *Selandriidæ* is a female without traces of wings. Affected by this absence of wings, the thorax undergoes important changes, and appears greatly swollen, and all the females generally have the appearance of little bugs. Its relation to this family is said to be astounding, since it is the only example of the wingless form in the whole family of saw-flies. All the other specialities of structure, however, as well as the wings of the male, confirm it.

One of the first lists made of the butterflies and moths of Turkistan enumerated 367 species, of which 122 species were of *Microlepidoptera*. The great majority (284) were caught in the oases and hilly districts between 750 and 4500 feet above the sea; 41 species also were taken on mountains up to 8000 feet high, and 28 species from 8000 to 13,000 feet. Mr. Alpheraky, of Taganrog, has furnished me with a list in manuscript of 377 species of Lepidoptera collected by him in 1879 in the district of Kuldja and the surrounding mountains; but even these two lists [illegible] I am told, give only an incomplete enumeration [illegible] Lepidoptera of Turkistan, which contains a large [illegible] of new forms.

As we travelled from Tashkend to Khojend drag[illegible] were so numerous that we caught several specimen[illegible] tending a butterfly-net from our carriage. The neu[illegible] logical fauna, however, of Turkistan is only [illegible] known. Mr. MacLachlan has treated upward[illegible] species, most of them European in character, an[illegible] of them belonging even to Western Europe, whil[illegible] is also an unimportant mixture of the Indian elem[illegible]

There is a mingling again of the Indian elemen[illegible] orthopterous fauna of Turkistan, but the Indian [illegible] are much fewer than the European. This fauna [illegible] ticularly like that of South Russia, and it contains [illegible] number of West European species. The non-Eu[illegible] species are from South Asia, among which are a fe[illegible] more distant countries, particularly from Africa. [illegible] total number of species known in Turkistan exce[illegible] Among them should be mentioned two locusts, [illegible] third called locally *Prus*. Ravages of the former [illegible] been complained of in the neighbourhood of Perm [illegible] of the "*Prus*" in the Zarafshan Valley.

Of *Hemiptera* I have no list of species, but I [illegible] fine collection at Tashkend, made by Mr. Oshan[illegible]

I come, lastly, to [illegible], or intestinal worms. [illegible] species known in Turkistan, [illegible] are found in man, [illegible] in the dog and sheep, 2 each in the cat and goat, [illegible] each in the horse, ox, and marmot, [illegible] are found in [illegible] 2 in reptiles, and 1 in fishes. Of all the Verme[illegible] most interesting is what the Bokh[illegible] call the *r*[illegible] (*Filaria medinensis*). The parasite is found at Bok[illegible] and certain adjacent towns in the water of stagnant [illegible] which the natives drink, and suffer in consequence [illegible] the *rishta* disease. The worm develops under the [illegible] lengthening at the rate of about [illegible] week, [illegible] an abscess is formed, through which the head [illegible] of the parasite appears. The problem then is to ex[illegible] the animal entire. Native specialists insert a needle [illegible] one end is drawn out by the finger of the right h[illegible] whilst those of the left press [illegible] part. Rus[illegible] medical men wind all the animal on a [illegible] so mu[illegible] comes out daily without force, till the whole, mea[illegible] three feet in length, is extracted. If, however, the w[illegible] should break, thousands of fresh germs are liberated [illegible] the broken part, and the illness continues for sev[illegible] months. I met with an [illegible] remarka[illegible] and was given by the doctor [illegible] of the [illegible] which I brought in spirits to London.

The appearance of the [illegible] resembling cooked vermicelli [illegible] a piece of cloth. [illegible] brought to light some very interesting facts concerning [illegible] as *Filaria*, the first of which was that the germ of the para[illegible] cannot live in very fresh water, [illegible] the fact that the parasite appears only in those pla[illegible] where the people are forced to use standing water. [illegible] *rishta* is the last of the Turkistan forms [illegible] men[illegible] tion here, but I hope within a few weeks to publish ful[illegible] particulars, through Messrs. Sampson Low and Co., [illegible] new work entitled "Russian Central Asia, includ[illegible] Kuldja, Bokhara, Khiva, and Merv, with Appendix [illegible] the Fauna, Flora, and Bibliography of Russian Turkistan[illegible]

HENRY LANSDELL

## FIELD EXPERIMENTS AT ROTHAMSTED [illegible]

THE above Report, forwarded to us, bears the name [illegible] no publisher, and is not for sale. It therefore ne[illegible] be taken as a private issue, copies of which can only b[illegible]

[1] "Memoranda of the Field Experiments [illegible] the Farm and the Laboratory of Sir John Bennett Lawes, Bart. at Rothamsted, Herts. June 1884."

ad by application to Sir John Lawes at Rothamsted ark, St. Albans.

The task of reviewing matter of so condensed a charac- r as this is by no means easy. Ever since 1840, Sir John awes has carried out field and stall experiments on a cale well worthy of a national enterprise. Elaborate apers by this most enterprising of experimentalists, and is equally well-known coadjutor, Dr. T. H. Gilbert, have oured forth from Rothamsted during the entire memory of the present generation. During the last twenty-five years the scientific staff presided over by Dr. Gilbert has consisted of two, and sometimes three, chemists, and as many competent assistants, a botanical assistant, two to four computors and record-keepers, besides laboratory men. From 1847 to 1884 ninety-six memoirs have been contributed upon subjects bearing upon the soil, the plant, the atmosphere, drainage water, and rainfall, utilisation of sewage, animal nutrition, feeding-materials, manures, the occurrence of fairy rings in pastures, &c., &c. There is, in fact, scarcely a topic of agricultural or pastoral life which has not been investigated at this great English Agricultural station, and that through the enterprise of one man.

The Memoranda commence with a summary of rainfall and drainage extending backwards to 1851. Not only is the local rainfall given for each month over a period of nineteen years, but also the amount percolated through gauges of 20, 40, and 60 inches in depth of soil, the amount evaporated, and the amount retained by capillary attraction in the soil. Thus, as a general summary of the total rainfall, we find 45·3 per cent. percolated through 20 inches depth of soil, 47·4 per cent. through 40 inches of soil, 41·9 per cent. through 60 inches of soil, as indicated by rain- or drain-gauge, while the remainder is accounted for by evaporation or retention in the interstices of the soil. The averages obtained by unremitting observation from 1851 to 1870 are used in comparison with subsequent years, as in the case of the last completed record from September, 1882, to August, 1883. The three last columns of the tables given are devoted to the nitrogen removed in solution by percolation of drainage-water calculated in pounds per acre, by which we see that, at the depths above-mentioned, from 36 to 44 lbs. of nitrogen per acre are annually carried down from the upper layers of the soil to a depth of 5 feet and more.

One of the most attractive series of experiments, extending now over a period of thirty years, is that carried out upon permanent grass-land in the Park at Rothamsted. Space forbids more than a most cursory sketch of these experiments. Like all the Rothamsted investigations, the first aim is practical and comparative. The questions asked are as follows:—What is the effect of various applications to grass land? Which gives the largest return? What is the effect upon the herbage of continuous and of varied treatment? What is the effect upon the soil of long-continued privation and of long-continued *feeding* with simple and combined dressings? The investigation is at once chemical, physical, and botanical, and the change wrought in the character of the herbage of various contiguous plots of natural pasture, as well as upon the soil to a great depth, is most remarkable.

Perhaps the chief interest in the experiments upon crop cultivation will still centre around wheat. Broadbalk field, on the Rothamsted estate, is unique, so far as treatment and cropping goes. In 1839 this field carried a ...n of turnips, manured with farm-yard dung; in 1840 ... barley; in 1841, peas; in 1842, wheat; in 1843, ... the four last crops being unmanured. The field ...fore, according to all farming rules, in an ...ate when the first experimental crop of wheat ... 1844. Every year since 1843 has this field ...nd, with some exceptions, nearly the same ...nure has been applied to each plot. In ... during the present summer, will see the forty-second wheat-crop growing without manure of any description upon the unmanured portion of the field, still keeping up a wonderfully uniform yield of about thirteen bushels per acre—or about the average yield of wheat-lands in the United States of America. This is a striking fact for those who fear the eventual exhaustion of our soils. Equally startling is the result from the continued use of nitrate of soda year after year. This fertiliser is looked upon by many landlords and agents with suspicion as a stimulator and exhauster of the soil; and yet after forty-one years application of nitrate of soda, and nothing else, we have the astounding result of an average of 23½ bushels per acre, or double the yield of the unmanured plot. And, although it is true that the yield of the unmanured and nitrate of soda plots is less upon an average from 1868 to 1883 than it was from 1852 to 1867, yet it is equally true of the plot manured with 14 tons of farmyard manure annually; and this falling off is therefore probably due to a succession of bad seasons, more than to any actual exhaustion of the soil. Another striking fact brought out in these experiments is the excellent results achieved by applications of artificial fertilisers as contrasted with those obtained from farm-yard manure. In the latter case, where 14 tons of dung have been annually applied to the wheat-plot for forty years in succession, the very satisfactory yield of 33½ bushels per acre has been obtained over the entire period. When, however, a well-compounded mixture of artificial fertilisers has been applied, a larger yield has been obtained. For example, 200 lbs. of sulphate of potash, 100 lbs. of sulphate of soda, 100 lbs. of sulphate of magnesia, 3½ cwts. of superphosphate, and 600 lbs. of ammonia salts, have given upon an average over the same long period 36 bushels per acre year by year. We must not draw these remarks to a conclusion without at least noting the interesting experiments upon barley, the leguminous crops, clover sickness, root crops, and potatoes. The memoranda close with a synopsis of a series of experiments upon rotations of crops commenced in 1848 in order to test the effect of growing crops in rotation, instead of continuously, and so to arrive at precise results when a system of mixed farming is pursued with and without manures, and in conjunction with sheep farming.

JOHN WRIGHTSON

## *RECENT EXPLORATIONS OF THE PAMIR*

THE third fasciculus of the *Izvestia* of the Russian Geographical Society contains three very interesting papers, by D. L. Ivanoff, on the Pamir, being the results of the expedition of MM. Ivanoff, Putyata, and Bendersky, already mentioned in NATURE. The first of these papers deals with the journeys of the members of the expedition; the second contains the author's views on the orography of the Pamir; and the third gives a description of the flora, fauna, and inhabitants of this "Roof of the World." Leaving aside the purely geographical part (M. Ivanoff's papers should be translated into English), I shall sum up the most important orographical results arrived at by the author, as also his observations on the natural history of the Pamir.

As to its limits, so variously determined by geographers, M. Ivanoff places them—rightly in my opinion—as follows:—The Alay Mountains in the north, the Hindu-kush in the south, and the Kashgar Mountains in the east. As to its western limits, the following remarks ought to be made:—The whole of the highlands on the upper Amu-daria must be divided into two parts—the Eastern Pamir and the Western. The Eastern Pamir is a very high plateau, intersected by numerous valleys, rivers, and lakes, with an average height above the sea-level of 12,000 feet (from 10,000 to 14,000). These valleys are either separated by chains of mountains or by low swellings which mostly reach only from 1100 to 1500 feet above the level of the surrounding valleys, and very seldom 3000 feet. The slope of these swellings above the valleys is so gentle that water-sheds only 1100 to 1500 feet high are often twenty to fifty miles distant from their foot. These high valleys strictly correspond to what the inhabitants call "Pamir." "Pamir" signifies, in fact, "a flat roof," and when the inhabitants want to describe it in more detail, they add: "broad valleys between low mountains, so high, however, that nothing but grass may grow on them; where there is nothing," they say, "and the earth is like the palm of the hand, that is the Pamir." So they describe what a geographer would call a High Plateau. This plateau has, on the whole, the shape of a great horse-shoe, in the middle of which are situated the mountains of the Murghab and Alichur. This does not imply, however, that there are absolutely no mountain-ridges on the plateau; no *angehaufte Gebirge*, as Karl Ritter would say. The Pamir chain of mountains which runs east-north-east between the Pamir and the Alichur rivers in the south belongs to this category. It rises above the Great Lake as a stone wall 3500 to 5000 feet high; but it has its foot in the 10,000-feet-high valleys which surround the lake, and belongs to the category of the *angehaufte Gebirge*. Several other lower chains, such as the Alay, Trans-Alay, Riang-kul, Murghab, Alichur, and Vakhan, run in the same direction over the surface of the great plateau, and have the same character.

As to the Western Pamir, which might be described as the mountainous Pamir, it has quite another character. The whole of the plateau sinks towards the west, but, at the same time, numerous chains of mountains make their appearance. We have there, according to Ritter's classification, an Alpine country. The rivers, which flow lazily in the east, become rapid, their valleys narrow; crags, rocks, and hills confine them; the routes become difficult, and the mountain-passes very rare. The rich prairies of the east disappear also, giving place to forests, and, lower down, to agriculture, which rises as high as 8000 feet in the north and 10,000 feet in the south. Even the inhabited valleys are mere mountain-gorges. It is obvious that, under such conditions, the real western limits of the Pamir cannot be determined with exactitude; and we consider M. Ivanoff very near the truth when he says that the Western Pamir merges into the Alpine highlands of the Darwaz, Shugnan, and Badakshan. The limits are thus far more undefined in the west than in the north and east. The author considers, thus, that the Shugnan and Darwaz ought not to be included in the Pamir proper; they might be considered rather as a highland which has risen at the intersection of the eastern with the north-western ones of the Hindu-kush (as border ridges?). The Pamir would thus appear as a mighty plateau about 170 miles long, 200 miles wide in the meridional direction, and covering nearly 34,000 square miles.

As to the much-spoken-of meridional upheaval of the Bolor, M. Ivanoff points out that there are absolutely no traces of upheavals having a direction either from north to south, or even towards north-north-west or north-north-east. On the contrary, all his observations on the stratification of rocks—and they are numerous—show that the stratification follows the direction either of east-north-east (that of the whole Central Asian plateaux), or north-west, that is, that of the Hindu-kush. The same is true with regard to longitudinal valleys, which always follow a direction towards north-north-east. As to the Kashgar Mountains, still unexplored, they seem to represent a repetition of shorter chains running towards north-west, and arranged in *échelon*.

If this opinion of M. Ivanoff is confirmed—and it most probably will be, as it pretty well corresponds with the broad lines of the structure of the Central Asian plateaux, as also with what is already known as to their structure—we shall have definitely to renounce seeking for meridional chains in this part of Asia. We have already been brought to renounce them in North-Eastern Asia, where I believe I have proved that neither the Great Khingan nor the Kuznetsk Alatau, nor even the Sikhota-alin, have this direction. On the contrary, we will perceive that the Pamir is only the highest terrace of a series of plateaux extending throughout the central parts of Asia in a north-eastern direction from the source of the Amu to Behring Strait.

But let us return to M. Ivanoff's papers, and to his observations on the flora and fauna of the Pamir. The high valley of the Alay already belongs to the Roof of the World. It is covered with rich prairies, the chief elements of which are Gramineæ. Nearer to water you find a thick growth of *Carex physodes*, which has given its name, *Riang*, to so many parts of the Pamir highlands. Numerous species of Papilionaceæ, many of them relations of the flowers of our European meadows, give a pleasant aspect to the steppes of the Alay in June. The same character—a mixture of the vegetation of the steppes with that of cold climates and highlands—is found also on the Eastern Pamir as you advance further south. But it is sufficient to descend into the valleys of the west to find immediately a far richer flora and, very soon, corn-fields.

The animals inhabiting the Pamir are also a mixture of those of the steppes with those of Alpine regions. The tame yak (*Bos indicus*) is met with the well-known "arkhars." Although their horns are scattered in great numbers on the Pamir, they are far from disappearing, and M. Ivanoff has seen numerous herds of from 100 to 150, and considers that they ought to be counted by thousands in the neighbourhood of the Great Lake. In the mountains the "kiiks" (*Capra*, probably *sibirica*) are numerous, but very difficult to approach; the brown bear is common, and M. Ivanoff's men killed four of them. The wolf of the steppes unavoidably accompanies the herds of arkhars. The yellow marmots (*Arvicola caudatus*) are very numerous; the steppes of the Pamir are their true dwelling-places, and the expedition has met also with great numbers of small Siberian hare, which is common on the Issyk-kul. The Indian goose, the *Syrrhaptes* of the high steppes, the *Megaloperdix tibetana* in the rocky hills, and the *Perdix chukar*—this last met with only once at a height of 14,000 feet—are especially worthy of notice.

As to the climate of Pamir, it is, of course, very severe. The winter reigns in full for seven months. As to frosts, there is hardly one single month without them, and even on July and August nights the expedition experienced frosts of 6° below zero. There are places on the Pamir where snow rarely reaches a great depth, but, its distribution depending mostly upon the prevailing winds, there are places where it falls in thick layers. As to the rivers, even the Murghab freezes for some time.

The true inhabitants of the Pamir are the Kirghizes, namely, the Kara Kirghizes, who belong to four different stems—Teit, Gadyrsha, Nayman, and Kiptchak. The chief settlements are situated in the valleys of the Northern and Southern Ghezia, about the Riang-kul, on the Ak-baital, the Ak-su, the Alichur, and in the basin of the Kokui-bela. They are found also on the Upper Tagarma. These Kirghizes are very much like those of the Alay, but a special feature of them—very rare, on the whole, with the Mongolian race—is that they continually suffer from tooth-ache; perhaps it depends upon the climate; at any rate, common disease—an inflammation of the eyes—obviously depends upon the clouds of salt dust raised on the Pamir by the western winds. They spend the winter, at a height of 11,000 to 12,000 feet, in the same tattered *kibitkas*, that they inhabit in the summer, and know nothing of the warm dwellings erected for the winter by the Alay Kirghizes.

In the summer they ascend to the hilly tracts, reaching about 14,000 feet, in order to save their cattle from the mosquitoes. Though living chiefly on milk produce, they still are dependent upon the inhabited countries of the west, for they are accustomed to the use of bread. The other race inhabiting, if not the Pamir itself, then its outskirts, are the Tadjiks. In the high valleys of the Shugnan, the Roshan, the Darwaz, and the Karategin, they occupy the narrowest gorges of the mountains, trying to escape there from the persecutions of their khans, who are themselves vassals to the neighbouring larger states like Bokhara, Kokan, or China. Being Shiites, they are still more persecuted by their Sunnite rulers. Their dwellings are miserable hovels built of rough stones. Broad wooden platforms, under which fowls and young goats are kept, are divided into numerous compartments, which might be called rooms, each of them having its special destination as a kitchen or as a room for weaving, and so on. Notwithstanding the surrounding poverty, one feels comfortable in their poor hovels, the walls of which are decorated with numerous clay pillars, niches, and a variety of paintings very artistically made by the women, who have found the means of fabricating even boxes from clay mixed with husk. The pottery, all made by women without instrumental aid, is striking in the artistic feeling infused into its fabrication. Their fields are not less striking by the incredible labour which has been spent in clearing them from millions of stones. There are "fields" not larger than a common-sized table, cleared with effort, or artificially made by the side of a mountain stream. They keep some cattle, and, during the summer, mount with it to higher tracts. The Pamir is visited by many *savdagars*, or traders, from Kashgar, Badakshan, or Ferghana, who supply the Kirghizes and Tadjiks, at very high prices, with manufactured produce, receiving in exchange their own produce.

M. Ivanoff remarks that the small preliminary map published in the *Izvestia*, to illustrate the explorations of his expedition, is still incomplete, and does not quite correctly represent the results of his investigations. The larger completed map will therefore be welcomed when it appears.

P. K.

## *NOTES*

A MEETING of the General Committee of the Darwin Memorial Fund was held last week at the rooms of the Royal Society, Prof. Huxley, President, in the chair, when it was stated by the treasurer, Dr. Evans, that, after payment for the statue and other expenses, a balance of about 2200*l*. would remain. The following resolutions were then passed:—"That the statue of Darwin be made over to the Trustees of the British Museum in trust for the nation." "That the balance of the fund, after payment for the statue and medallion and incidental expenses, be transferred, under the name of the 'Darwin Fund,' to the President, Council, and Fellows of the Royal Society in trust to invest the same in or upon any stocks, funds, or securities authorised by law as investments for trust moneys." "That the President and Council of the Royal Society apply from time to time the dividends and interest of such investments in such a manner as shall to them appear best calculated to promote biological studies and research." "That a list of subscribers and a statement of the accounts be printed and circulated, together with the resolntions now passed, and that a woodcut or some other representation of the statue accompany the statement." The statue, by Mr. Boehm, R.A., has been placed in the great hall of the British Museum (Natural History), Cromwell Road, and arrangements for its unveiling will be made shortly.

THE vacancy created by Prof. Bayley Balfour's retirement from the Regius Chair of Botany in the University of Glasgow, which we announced some time back (NATURE, March 12, p. 441), has been filled by the appointment of Mr. F. O. Bower, F.L.S., Lecturer on Botany in the Normal School of Science, South Kensington. Both as a teacher and by his important researches in the morphology of Gymnosperms and the Vascular Cryptogams, Mr. Bower has rapidly assumed a leading position amongst the younger generation of botanists, and the loss of his services to the Normal School is much to be regretted. Mr. Bower is an M.A. of Trinity College, Cambridge.

THE Goldsmiths' Company has contributed one hundred pounds towards the fund which is being raised for the family of the late Henry Watts, to which we have already drawn attention in these columns.

THE Court of Assistants of the Fishmongers' Company has unanimously resolved that a grant of 2000*l*. be made to the Marine Biological Association of the United Kingdom—1000*l*. to be paid this year, and the remainder in annual sums of 200*l*. during the next five years.

THE subject of Mr. Romanes's Rede Lecture on June 2 will be "Mind and Motion."

THE subject of Prof. W. G. Adams's British Association address will be "The Electric Light and Atmospheric Absorption."

AT a meeting of the directors of the Ben Nevis Observatory held on Thursday last week, it was agreed to add a printing press to the establishment, for printing each day the hourly observations, with a view to their distribution among the more distinguished meteorologists and prominent meteorological institutions in different parts of the world.

THE verdict of the jury who considered the case of the Usworth Colliery explosion, whereby forty men and boys were killed early in the present year, is important as marking what appears to be the commencement of a new era in the history of these phenomena. It is probably the first expression of opinion from a public body of this class to the effect that coal-dust and a small percentage of fire-damp can play the part that has hitherto been usually ascribed to fire-damp alone. They found that the explosion was caused by a shot, the fire of which acted upon "*the coal-dust and a small percentage of gas*." The convenient and time-worn "outburst of gas" theory, which consigned the helpless miner to the vicissitudes of chance, and exonerated colliery owners and their agents from all responsibility, seems on the point of giving way before its rival the coal-dust theory, which points out an easy means of preventing great explosions of this kind. The latter theory has doubtless a hard battle still to fight against prejudice and ignorance, but it has all the advantages of youth and vigour on its side, and is supported by a number of facts which appear to be incontrovertible.

THE Russian Geographical Society has just issued a programme of climatological and phenological observations, which, it is to be hoped, will be adopted by numerous observers. The number of plants and animals enumerated is smaller than in most similar programmes, it being the aim of the Society to make the task of the observers as easy as possible. A new feature of this programme are observations on the condition of the snow covering the ground, the time of its appearance and thawing, the rise of water in the rivers at the melting of the snow, &c.

M. FAYE has been continued on the roll of teachers of the Paris Polytechnic School, in spite of his having passed the time of incapacitation by old age. The exception has been grounded by the Minister of War on the plea of continued services rendered to science. A banquet has been given to the worthy astronomer by his admirers on this occasion.

THE Sanitary Congress opened yesterday at Rome.

IN the Spanish Congress on Monday, Señor Castelar called attention to Dr. Ferran's experiments in inoculation against cholera, and asked the Minister of the Interior to give a subvention to enable Dr. Ferran to continue his experiments on a larger scale. The Minister, in reply, said he was unable to do so at present, but as soon as it lay in his power he would grant a sufficient sum, although, in his opinion, Dr. Ferran's experiments had not yet reached a sufficient degree of certainty to prove a complete success. He added that a commission of medical men would be appointed to visit Valencia and other towns in order to study the experiments that are being made. In reference to this subject Dr. Cameron, M.P., writes to the *Standard* that the Under Secretary for Foreign Affairs has promised to instruct the British Minister at Madrid to send home translations of any reports bearing on the system of inoculation with cholera virus attenuated by artificial cultivation, as a protection against Asiatic cholera, discovered by Dr. Ferran, of Valencia. This having come to the notice of Dr. Ferran, that gentleman has sent Dr. Cameron a telegram giving the results up to date of a great test experiment which is at present being conducted by him, under the eyes of scientific commissioners at Alcira, a town near Valencia, where an epidemic of cholera is raging. According to Dr. Ferran's telegram the population of Alcira is 16,000, and since the first of the present month 5432 of its inhabitants have been inoculated with his protective virus. This would leave the number of those not inoculated about 10,500; or, accepting 16,000 as an exact figure, precisely 10,568. Of the 10,500 persons who are not inoculated, cholera has attacked 64, and proved fatal in 30. Of the 5432 who have been inoculated it has, according to Dr. Ferran, attacked only 7, and proved fatal in no single case. In other words, since the commencement of the experiment on May 1, one person out of every 163 has been attacked among the uninoculated population, and one person in every 352 has died of cholera; while among the inoculated population only one person in 776 has been attacked, and not a single person in the entire 5432 has died of the disease. Dr. Ferran concludes his telegram by expressing the desire that a British Commission should be sent to Alcira to verify these results.

THE floating dome presented by M. Bischoffsheim to the Observatory at Nice is now finished, and has been on exhibition in Paris during the past weeks. It is intended to cover a colossal telescope; it is 22 m. in diameter inside, and has a circumference of 60 m., or 2 m. more than the dome of the Pantheon. Instead of [illegible] on rollers, according to the ordinary method, it is floated [illegible] a reservoir for air, which [illegible] the water in [illegible]. This system of suspension [illegible] to be so perfect, that in spite of its great weight, a single person [illegible] turn it completely round the horizon. To provide against the water freezing, it has been proposed to dissolve in it a salt to the point of saturation, but it is feared that this may cause corrosion of the apparatus. Frosts, however, are rare in Nice, and special experiments on the subject will be made.

ON Friday night the House of Commons agreed, without a division, to a motion by Sir John Lubbock for a select committee to inquire whether, by the establishment of a forest school, our forests and woodlands could be rendered more remunerative. The proposer pointed out that, while our interests in the subject were greater than those of any other country in the world, as we had 2,800,000 acres under wood in Great Britain and about 340,000,000 in the Colonies, yet this was almost the only country without a forest school. He referred to the effect of scientific forestry in the Landes in France, and in India, where the net forest revenue fifteen years ag[o was] 52,000*l.*, while, since the establishment of a forest [illegible] it had risen to over 500,000*l.* per annum. As a resu[lt] of the science in this country, students for India [were] trained at Nancy, a school of course specially a[dapted to] French requirements, and the forests in our Colonie[s and] possessions (Cyprus and the Cape, for example) had [been] under the control of foreigners, as there were no [illegible] trained for the work. Sir John Lubbock, however, [did not] commit himself to the establishment of a Governme[nt school;] it could not be left altogether to private enterprise, [as a] school necessarily required access to a considerable are[a]. He thought it worthy of consideration whether som[e] [illegible] system might be adopted which would enable [one] or more existing institutions to benefit by national fo[rests]. Gladstone, whose interest in arboriculture is well kno[wn], did not bind the Government to the establishment of a [school of] Forestry, although he recognised the universal ignora[nce on the] subject prevailing amongst land agents and others [illegible]. He distinguished the circumstances of India, where [illegible] important facts connected with the climate, and wit[h the] supply of moisture in the atmosphere, which are not [found in] this country. The School of Forestry, moreover, which was established by the Indian Government in [illegible] was open to every one who could pay the fees. Then the difficulty that forests of large extent were rare here; they are kept, not for purposes of profit, but of landsca[pe] or pleasure and sport. In conclusion he said the Go[vernment] gave their hearty approval to Sir John Lubbock's [motion,] reserving, at the same time, their freedom with rega[rd to the] recommendations which the committee might make.

A TRANSLATION of Prof. Cremona's well-known wo[rk on the] "Elements of Projective Geometry," by Mr. C. Le[udesdorf,] of Pembroke College, Oxford, will shortly be published [by the] Clarendon Press. It is hoped that this may at[tract] [stu]dents of a subject which has been comparatively neglected in this country, although much attention has [been given] to it on the Continent. The opportunity has been [taken to] considerably enlarge and extend the work. All the [illegible] to be found in the French and the German edi[tions have] been incorporated, and a new chapter on "[illegible]" added. The text has been carefully revised throughout [and has] received many additions and [illegible] made by [the author] himself and others to the translator.

ON the night of Friday the 15th inst. one of the mo[st] [illegible] in Vienna [illegible] there, by whi[ch] trees and even houses were [illegible], and the cold so [illegible] was so severe that several persons exposed to it du[ring the] night were found frozen to death in the morning. In [the] *Bulletin International* of the morning of the 16th it [is stated] that 430 millimetres of snow fell at Vienna. In al[l of] Austria and Hungary snow covered vineyards and fiel[ds,] the crops were in an advanced condition, and incalcula[ble] damage has been done. The festivals of Pancratius, S[ervatius,] and Bonifacius, the Ice Saints of 1885, will long be rem[embered] in this part of Europe.

WE have received the report of the Rugby School [Natural] History Society for the past year. The portion of [it] relating to the Temple Observatory at Rugby has alrea[dy been] noticed in these columns. The editors observe that it [illegible] to be a law of the existence of the Society (like the [illegible] animalcule *Amoeba proteus*) that as one kind of life dies [illegible] produces a corresponding decline in another. For [illegible] the botanical, geological, and ornithological sections [illegible] all energy, but now there is a decided movement towar[ds] [illegible] and a decline in those sections once so vigorous. A [illegible]

; been made with some zoological collections; the aquarium, wever, has proved a failure, and the vivarium labours under the advantage of never being reached by the sunlight. Several irt and interesting papers are published with the report.

THE Russian Government has sent an official of the Education partment to Vienna to study the State commercial and indusil schools of Austria, these establishments being regarded as odels, and the Russian Government intending to organise nilar ones.

THE Fish Culture Department at the International Inventions hibition has proved a great success and attracted a large conurse of visitors. During the past week many important addions have been made, including a magnificent model of a Fish ilture Establishment exhibited by Mr. T. J. Mann, and a ries of oyster beds, demonstrative of the process of breeding id fattening oysters. A special feature has been made of sters this year in the Aquarium, where they are to be seen in imerous varieties imported from various quarters of the globe. 1 close proximity to them are exhibited various dredges and nplements used in this particular fishery.

THE Count Lütke Medal of the Russian Geographical Society as been awarded this year to a work which deserves a special otice. It is Prof. N. J. Zinger's work on the determination of me by means of corresponding heights of different stars (transted in German by H. Kelchner, and published at Leipzig with preface of O. W. Struve, under the title: "Die Zeitbestimmng aus correspondirenden Höhen verschiedener Sterne.") The etermination of time with great exactitude, for telegraphic eterminations of longitudes, by means of easily transportable istruments, has already occupied the Pulkowa astronomers. V. Struve and W. K. Döllen proposed very skilful methods of bservations. The latter had proposed to determine the time by means of a special Repsold's circle from two passages of wo stars in the prime vertical. The exactitude reached by this neans was from 0·05 to 0·06 of a second; the circle had to emain in an unaltered position for no more than five or six ninutes; but the whole observation took about forty minutes. 'rof. Zinger's method, which is a further development of the work begun by Maupertuis, Olbers, Hauss, Delambre, and Knorre, consists in making two successive observations of two tars chosen for that purpose, at the same altitude, by means of any instruments which may not be divided with great perfection, out whose level would only show the changes the telescope may undergo when directed on two different azimuths. This method was met first with some coolness, on account of the difficulty of finding two stars which would culminate soon after one another at the same altitude. But M. Zinger has shown that even with a moderate telescope it is easy to have two stars easily found and pretty well seen at daylight which pass at the same altitude at an average of no more than nine minutes one after another. His tables render the task of finding such stars very easy, there being in moderate latitudes no less than 160 pairs of stars appropriate to that purpose. As to the ease and accuracy of the method, it is sufficient to say that time is determined with a probable error of no more than 0·04 of a second in no more than half an hour, without even making use of the divisions of the Repsold circle, and with only one reading of the microscope. For several years Prof. Zinger's method has been submitted to a very extensive test by Russian astronomers. So we learn from Gen. Koversky's analysis of it, published in the last "Annual Report" of the Geographical Society, that, when determining by means of light-signals the difference of longitudes between Pulkova and Parlovsk, and using a very plain instrument prepared by M. Brauer on M. Zinger's principles, the difference has been determined with an error of only one-fiftieth of a second. M. Pyertsoff, in Mongolia; Gen. Stebnitzky, in the Caucasus, who considers the determinations of time from corresponding heights of two stars quite as accurate as that deduced from zenithal distances taken with a Repsold circle, but far shorter and easier; the Russian officers in Bulgaria, who have determined with telegraphic signals the longitudes of thirty-seven places in less than seventy evenings, spending no more than three hours each evening for a determination which gave the longitude with an error of only 0·04 to 0·02 of a second; the measurements around Omsk in 1878; those of M. Gladysheff in the Transcaspian, and of M. Mionczyorski on the Ural in 1882-84—all these have been made on the same method of Prof. Zinger, which has now become the most familiar one with Russian astronomers. The measurements are usually made with a Repsold's circle, which is ready for work half an hour after the astronomer has arrived at the place whose longitude he proposes to determine; and in chronometrical expeditions five minutes to a quarter of an hour of a bright sky give the possibility of measuring the longitude with an accuracy quite sufficient for geographical purposes.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mr. James Fleming; a Common Badger (*Meles taxus*), British, presented by Mr. C. Ethelstone Parke; a —— Wild Ass (*Equus taeniopus* ♂) from the Island of Diego Garcia, Chagos Archipelago, presented by Mr. F. D. Lambert, jun.; a Common Squirrel (*Sciurus vulgaris*), British, presented by Mrs. G. A. Smith; four Red-faced Weaver Birds (*Foudia erythrops*) from South Africa, a Grenadier Weaver Bird (*Euplectes oryx*) from West Africa, presented by Mrs. Herman Kuhne; a Dominican Kestrel (*Tinnunculus dominicensis*), a —— Bittern (*Ardetta* ——), three Martinican Doves (*Zenaida martinicana*), two Moustache Ground Doves (*Geotrygon mystacea*), a Tuberculated Iguana (*Iguana tuberculata*) from the West Indies, presented by Dr. A. P. Boon; two Harvest Mice (*Mus minutus*), British, presented by Mr. G. W. Oldfield; two Demeraran Cock of the Rocks (*Rupicola crocea* ♂ ♂) from Demerara, presented by Mr. T. C. Edwards-Moss; two Mute Swans (*Cygnus olor*), British, presented by Mr. J. W. Gibson; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Master C. A. Greeven; three Common Vipers (*Vipera berus*), British, presented by Mr. W. H. B. Pain; four White-faced Tree-Ducks (*Dendrocygna viduata*), a White Gannet (*Sula piscata*) from Brazil, deposited; a Dark Green Snake (*Zamenis atrovirens*), South European, purchased.

## GEOGRAPHICAL NOTES

THE following message from Col. Prjevalsky, dated Lob Nor, March 15 (probably O.S.), is published in the *Invalide Russe*:—"During the last autumn and winter we visited Eastern Zaidam as far as Lob Nor. The middle range of the Kuen Lun, hitherto unknown, has been examined with sufficient care. The ancient route leading from Khoten to China has been found and thoroughly explored. We have also discovered three enormous snow peaks, to which we have given the names of Muscovite, Columbus, and Enigmatical. The most elevated point of the first-named is Mount Kremlin, of the second Mount Djinri, and of the third the Crown of Monomachus, which are all of a higher elevation than 20,000 feet above the sea. The Thibetan plateau, skirting the middle Kuen Lun, has an average height of 4000 feet. No inhabitants were met with except in the Southern Zaidam. Further to the west the flora and fauna of the desert are extremely poor. In the month of December the cold was so intense that the mercury froze. We passed the month of February and the first fortnight of March at Lob Nor. We are just about to set out again, with the intention of crossing Cherchen, for the purpose of reaching Kiria, in the district of Khoten. During the three months of summer we shall traverse Northern Thibet, if the Chinese do not oppose us, and in the autumn we shall return to our own Turkestan. We are all in good health."

THE last issue of the *Izvestia* of the Russian Geographical Society (1885, 1) contains a very interesting paper, by M. Lessar, on "South-Eastern Turcomania," with a map, thirteen miles to an inch, of the region between Merv and Herat. This paper consists of a chapter on the occupation of Merv; a diary of the journey from Kelesman to Penj-deh and in the Steppes; a geographical sketch of South-West Turcomania; and a translation of Sir Henry Rawlinson's note, by which M. Lessar's account of his first journey was accompanied in the *Proceedings* of the Royal Geographical Society, with a few remarks by the author. Capt. Alikhan's remarks on South-West Turcomania and the Badhyz are also translated in an appendix. The geographical description of the region comprised between the oasis of Merv, the Murghab, the Borkhut mountains, and the Hari-rud, which region is described as "South-Western Turcomania," is especially worthy of notice, as a valuable contribution to the geography of the region.

THE Government of India has decided to appoint Mr. Ney Elias, one of the most distinguished of our Chinese travellers, and at present English Commissioner in Ladakh, to act as British Consul at Yarkand and Kashgar.

MR. HOLMAN BENTLEY sends to the *Times* news of the safe return of the Rev. G. Grenfell, F.R.G.S., to the Baptist Missionary Society's steamer the *Peace*, after a voyage on the Upper Congo River from Stanley Pool to Stanley Falls, a distance of 1060 miles. He has explored many of the tributaries on the way—the Mobangi to 4° 30' N. lat., the Ukere to 2° 30' N., and the Lubilanji to 1° 30' S. The Mbura is navigable only for ten or twelve miles from its junction with the Congo, when cataracts bar the way. The Mobangi is a fine river, but the people are very wild.

IN a recent number of *Das Ausland*, Herr Habenicht, of Gotha, makes an important suggestion with regard to observations in Africa. He points out the dearth of accurate observations in latitude, longitude, and heights in the interior of that continent. For instance, with regard to the greatest part of North Africa we are dependent on those of Vogel and Barth, while in South Africa those of Livingstone are almost the only ones we have. Even in the interior of the Cape Colony, the Orange Free State, the Transvaal, Namaqualand, the Kalahari desert, our knowledge of exact positions is still in the air. More is known of the central and lower Congo and the coast. To remedy these defects, Herr Habenicht proposes to geographical societies interested in African exploration that the field should be subdivided. Young men should be trained to make astronomical observations, barometrical measurements and itineraries, and two should be despatched on each route with separate sets of instruments. The routes suggested are the following: (1) Cape Town, through Stellaland, to the Zambesi; (2) Delagoa Bay to Stellaland; (3) Cape Town, through Namaqualand and Damaraland, to the Zambesi; (4) Loango to Zanzibar; (5) Zanzibar to the Egyptian Soudan; (6) the Lower Niger, through Darfur, to Khartoum; (7) the Gold Coast to Timbuctoo; (8) Morocco to Timbuctoo; (9) Tripoli to Sokoto; (10) Benghazi, through Kufra and Borgu, to Kuka. All previous explorations, he says, would by these observations receive a sound scientific basis.

M. RADDE, the Director of the Natural History Museum at Tiflis, has been ordered by the Russian Government to investigate the mountain systems of the border lands of Trans-Caucasia and Khorassan, between Ararat and Ala Dagh on the west and Elburz on the east.

FROM a report addressed by Col. Feilberg to the Argentine Minister of Marine on the subject of his mission to explore the Pilcomayo River, it appears that this stream is only navigable for eighty leagues from its mouth in the Rio Paraguay up to its confluent, the Rio Dorado. Five miles higher the rapids commence; there is then only two feet of water, the channel is narrow and very tortuous, and the current swift. The upper waters are lost in marshes, which the traveller crossed. On returning, the water had fallen considerably, and the journey was only accomplished with much trouble and after many accidents. During his stay on the Chaco he reports that he did not see a single Indian, although their tents were still standing in places. One of his officers had been sent with the chronometers to Corrientes, to compare them by telegraph with the Observatory of Cordoba or Buenos Ayres. These comparisons are essential for the verification of the observations made, and as soon as they have been obtained, the maps which are to accom[pany] publication of the journal of the mission will be comm[enced].

ACCORDING to the *Colonies and India* a conference [was held] on March 31, by telegraph, between the Melbourne an[d] branches of the Geographical Society of Australia, on [the ques]tion of New Guinea exploration. It was decided to [assist] Mr. H. O. Forbes's expedition, to the extent of 500*l.*, [on con]dition that the two Colonies receive copies of the explor[er's] and despatches, and duplicates of his collection of sp[ecimens]. The Conference also decided to send an independent e[xpedition] from the Aird River, the whole expenses to be defraye[d by the] Society. The expedition will be placed under the lead[ership of] Capt. Everill, who will be accompanied by Herr von Le[...]

THE Report on the trade of Persia by our Consul at [...] which has just been laid before Parliament, contains so[me inter]esting statistics on the population of Persia, in order [to show] how far the country has recovered from the effects of t[he] famine of 1871–72. The area of the dominions of the [Shah is] 1,647,070 square kilometres, and the population is estim[ated at] 7,653,000, contained in 97 towns with a total popul[ation of] 1,963,800, while the villages and rural districts [contain] 3,780,000, and the nomads are estimated at 1,909,800. [It is] curious to notice how the number of nomads are made [up]: Arabs number 52,020; Turks, 144,000; Kurds and [...] 135,000; Beluchis and gypsies, 4,140; Bakhtiaris an[d ...] 41,800. The statistics of the creeds are: Sheeahs, 6,8[...] Sunnis and other Mohammedan sects, 700,000; Parsees, [...] Jews, 19,000; Armenians, 43,000; Nestorians and Chr[istians] 23,000. Of the Armenian population 52·8 per cent. are [males] and 47·2 females. Of the Mussulman population the pro[portion] is 50·5 per cent. females and 49·5 males. The fo[llowing] is a list of some Persian towns with their respective popul[ations]:—

| | | | |
|---|---|---|---|
| Tabreez | 164,630 | Zenjan | |
| Ispahan | 60,000 to 70,000 | Urumi | |
| Yezd | 70,000 | Resht (including adjoining villages) | |
| Kerman | 41,170 | | |
| Shiraz | 30,000 | Asterabad | |
| Shuster | under 20,000 | Nishapore | |
| Dizful | 25,000 | Sebzevar | |
| Burujird | 20,000 | Meshed | |
| Kermanshah | 30,000 | Kashan | |
| Hamadan | 30,000 | Kazvin | |
| Maragha | 13,250 | Miandb | |
| Soujboulak | 5,000 | Mohammera | |

Mr. Dickson, taking the medium between the highes[t and] lowest figures he has obtained, estimates the populati[on of] Teheran at about 120,000, while Col. Ross estimates th[at of] Bushire at 20,000.

IN *Astron. Nachr.*, vol. cx., Prof. Dr. Auwers has publ[ished] the results of his researches and calculations about the long[itudes] of some places in Australia. Since these data will have [to be] altered by the result of the determination of the differen[ce of] longitude between Port Darwin and Banjoewangi (Java) we [will] omit particulars and only state that Mr. Auwers has fo[und them] to be:—

| | h. | m. | s. |
|---|---|---|---|
| Longitude of Sydney | 10 | 4 | 49·75 |
| " Windsor | 10 | 3 | 20·92 |
| " Melbourne | 9 | 39 | 54·32 |
| " Adelaide | 9 | 14 | 20·53 |

INFORMATION has been received in Berlin of the death, i[n the] Cameroons, of Ernst Tilly, the leader of another German e[xpe]dition sent out to explore that part of Africa.

A PARLIAMENTARY paper just issued (Commercial, No. [...] 1885) contains an exhaustive report, by Vice-Consul Cam[...]hatch, on the Dobrudja. Under the head of geography it re[fers] to the name, limits, frontiers, area, topography, division, mo[un]tains, forests, mines, rivers, marshes, lakes, islands, harbo[urs] and tides of the district. This is succeeded by sections on [...] climate, history, ancient remains, population, variety o[f ...] government, public works, religion, education, agricultu[re,] commerce, industries, navigation, natural history, and princi[pal] towns. The report, which occupies fifty pages, is thus a sh[ort] treatise on this district at the mouth of the Danube, of wh[ich] much was heard in connection with political events a few ye[ars] ago.

FOR THE
o

. commencing at
on to 24. is here

[illegible] sets, 19h. 55m. [illegible]
[illegible] Time at Sunset,

[illegible]ouths, 20h. 59m. ;
[illegible]5' S.

| | | Decl. on meridian |
|---|---|---|
| 1 | .. | 11 3 N. |
| 4 | .. | 21 47 N. |
| 52 | ... | 14 50 N. |
| 4* | ... | 13 25 N. |
| 35 | .. | 22 21 N. |

following day

*Moon*

| Reap. | Corresponding angles from vertex to right for inverted image |
|---|---|
| h. m. | |
| 3 5 | 148 253 |

*[illegible]tellites*

| h. m. | |
|---|---|
| 20 46 | I. occ. disap. |
| 0 18 | I. ecl. reap. |
| 20 25 | I. tr. egr. |
| 20 56 | IV. occ. reap. |

[illegible]upiter's Satellites are such

[illegible] elongation from the Sun

[illegible]tion with and 3° 15' south

LABORATORY [illegible]
[illegible]ND REGULATION

[illegible]on has before now [illegible] on whom we depend [illegible] largely availed [illegible] [illegible] crops and [illegible] [illegible] almost equally [illegible] [illegible] the fishes on which they [illegible]

[illegible]

special skill—now lost—in cultivating sea fish. Whatever that may have amounted to, it is certain that modern Europe has entirely neglected the cultivation, and even the care of sea fisheries. It has been the merit of the Fish Commission of the United States to make the first attempt in modern times to deal with sea fisheries in the spirit of civilisation, that is of men who are determined to understand and control, for the advantage of their race, the operations of nature, rather than to leave things to chance, the unknown development of physical causes.

The direct [illegible] of the American Commission, and the knowledge which [illegible] men have accumulated with regard to fishes, without designing [illegible] on the regulation and development of fisheries, do not enable us at present to answer many of the questions with regard to different sea fishes which we urgently require to know if we are to deal like reasonable, practical men with our fisheries, so as to improve them, or even [illegible] prevent their extermination.

At the late Fisheries Exhibition Congresses, the universal cry, the one unanimous demand, was "more knowledge!" We cannot tell whether beam-trawling with steamboats is injurious or not to some of our most valuable sea fishes, until we have more knowledge. We have not sufficient knowledge to enable us to say that [illegible] would restore some herring grounds to their former richness, if the fishermen were kept off those grounds for a few years.

W[illegible] not know why soles are getting scarcer every year; we know nothing about soles, and so we can do [illegible] thing to remedy their constantly increasing diminution.

We do not know why oysters are scarce, or how to make them more abundant. A few haphazard attempts to cultivate oysters are now and then made, but have resulted in an immense loss of money rather than in gain, because we do not know all about oysters in the same precise and detailed way in which we know all about wheat, or all about pigs or chickens.

We do not know why some fishes swim in great shoals year after year at certain seasons near certain spots, and then to the dismay of the fishermen suddenly give up ever passing that way. We do not know whether we could hatch the young of soles, turbot, cod, and other valuable fishes, and stock the sea with them as we do our rivers with trout and salmon.

We do not know whether we could assist the increase of such fishes by cultivating [illegible] their favourite food. In many cases we do not know what their food is.

We do not know whether we might increase these fishes by destroying their enemies.

In fact, we know exceedingly little about the minute details of the life of [illegible] animals, and if we wish to deal with sea [illegible] like rational men, we must find out these minute details, and gradually apply the knowledge [illegible].

A laboratory [illegible] provided with boats and fishermen, [illegible] having within [illegible] tanks for hatching eggs and watching [illegible], and convenience for the work of naturalists [illegible] in making such observations, is the way to meet the [illegible] in our knowledge [illegible].

[illegible]

as will be not only valuable but actually indispensable to the practical fisherman; and in the reports of the work done in the new marine laboratory which will be published by the Association, I do not doubt that the basis for future legislation and for future methods of sea-fishery will be found.

I may here venture to mention some of the results obtained by the efforts of the naturalists who form the United States Fish Commission—at the head of which is Prof. Spencer Baird. I would, however, especially remark that the Commission has only been at work for ten years, and that very great practical results cannot be expected at once. A vast amount of knowledge has to be obtained before we can deal practically with all the various kinds of sea-fishes, and it is to me a proof of the wonderful sagacity and activity of the American naturalists that they have already been able to do what they have done in the practical direction.

Prof. Baird has especially attempted to artificially cultivate sea-fishes. It seems to him that it is better, if it be possible, to replenish the seas by stocking them with young fish, to take the place of those removed by fishermen, rather than to impose legislative restrictions and penalties upon the fishermen. The attempt to artificially cultivate sea-fish is an admirable example of the relation of scientific knowledge—that is, thorough and cause-searching knowledge—to practical commercial operations.

There are two distinct stages in this attempt at artificial cultivation. The first is the scientific. You must ascertain how, when, and where the fish naturally breeds; you must find out, experimentally, how to procure its eggs, fertilise them, and rear the young to a given size—on a small scale. That is the business of the scientific naturalist. When he has ascertained all the details of this operation—which differ entirely in the case of different fishes, and may take years to ascertain—then the second stage is entered on. The commercial man then comes forward, and in the light of the knowledge obtained for him by the scientific man, attempts the hatching of the fish on a large scale—not by the hundred, but by the million.

The American Fish Commission has undertaken both stages of the work, and the second is necessarily a very costly one. A very promising result has been obtained in the artificial breeding of codfish, and again in the case of the shad. [Details of these operations were here given by the author.]

Again in dealing with the American oyster, the Commission have obtained what promises to be a very great success. [Details of this case were given.]

But there is an almost unlimited field of work before the American Commission.

Experiments and observations similar to those [illegible] the American Commission, will be [illegible] by the Biological Association at Plymouth. For example, the artificial cultivation of that most valuable of British fishes, the sole, will be at once taken in hand. At present absolutely nothing is known as to the spawning of the sole—the most [illegible] fish [illegible]. In the first instance, the naturalists at Plymouth will study the eggs and the mode of spawning of the sole, and the way in which the eggs are fertilised naturally. Then the [illegible] for the rearing of the young fish will be [illegible]. After that it will be possible to hatch a vast number of young soles, and turn them out into [illegible] Sound, and [illegible] particular area [illegible] delimitation for the experiment, whether the [illegible] Sound has been [illegible] by the [illegible].

Similar experiments will be tried with [illegible]; and also knowledge will be gathered as to the food of [illegible], and the causes which determine their movements, [illegible] their dominance in the [illegible] of Plymouth.

This knowledge will help us to [illegible] elements as to the supposed injurious effects of [illegible] and other modes of fishing, and to lead on to sensible and suitable legislation in regard to the season and [illegible] of fishing best suited to obtain the maximum benefit from the harvest of the sea.

The English oyster, though differing from its American congener, can no doubt be brought under control by a thorough-going knowledge of all the conditions affecting it at all periods of life; and this it will be a first duty of the Marine Biological Association to attain. [Suggested inquiries as to the oyster were here mentioned.]

Lastly, the subject of "bait" is one of great importance, which we shall be able to deal with effectively. Not only shall we find new and effective baits, at present neglected by our line

fishermen, but we shall be able to direct the cultiv[ation of] valuable baits as the mussel and the limpet.

There is no fact which gives one so vivid an [idea of the] immense commercial value of sea-fisheries as the a[mount which] is annually spent on mussels for use as bait in [illegible]

[illegible]

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[illegible]

into what is known as a "link." Another plan was to flatten the cylindrical bulb into as thin a plate as possible, thus giving a maximum of surface in proportion to the contents. The bulb [illegible] we have the so-called "bottle" pattern [illegible] the side of the bottle, and both ends of the bulb left open, and so we have the "open" cylinder [illegible] glass-blowing.

[illegible]

With the assistance of Mrs. Draper, Mr. George F. Barker was accordingly requested to collect from Dr. Draper's copious notes the facts here detailed in connection with his experiments. Some supplementary measurements have also been made to test the efficiency of the apparatus.—The genus Pyrgulifera, Meek, and its associates and congeners, by Charles A. White. These molluscan forms, constituting the Bear River Laramie fauna of the author, are not found among any other North American fauna, either fossil or recent, but appear to have their congeners in a fauna still surviving in Lake Tanganyika, Central Africa, as well as in the Upper Cretaceous fresh-water deposits of Hungary.—On the occurrence of native mercury in the alluvium in Louisiana, by Ernest Wilkinson. Native mercury has recently been unexpectedly discovered at Cedar Grove Plantation, Jefferson Parish, Louisiana, where it is found disseminated in small globules in the mean proportion of 0·002034 per cent. throughout the alluvial soil. It also occurs elsewhere in the same region in such large quantities and under such general conditions that its presence can hardly be attributed to human agency. Yet no other explanation is offered of this curious phenomenon.—Remarks on the series of earthquakes that have recently devastated the southern provinces of Spain, by C. G. Rockwood, jun.—On the structure of the spores or spore-like bodies (*Sporangites huronensis*) of Sir J. W. Dawson) occurring in the Devonian formations of North America, by J. M. Clarke.—Denudation of the two Americas, by T. Mellard Reade. In this paper the author follows up the calculations already made by him regarding the quantity of matter annually removed in river water from the surface in England and Wales and some of the river basins of the European continent. Here the Mississippi, Amazons, and St. Lawrence basins are dealt with, the results confirming the provisional assumption that about 100 tons of rocky matter are dissolved by rain per English square mile per annum throughout the world.—On Arctic Interglacial Periods, by Dr. James Croll. It is argued that the Polar Interglacial periods were more marked than the Glacial, and that they neither did nor could exist *simultaneously* in both hemispheres. In a concluding note the author remarks that this will probably be his last paper on questions relating to geological climate, advancing years and declining health obliging him to abandon the subject in order to finish some work in a different field of inquiry which has been laid aside for over a quarter of a century.—Notes on some apparently undescribed forms of fresh-water Infusoria, No. 2 (with Plate III.), by Dr. Alfred C. Stokes.—Palæozoic notes; new genus of Cambrian Trilobites Mesonacis, by Charles D. Walcott.

*Bulletin de la Société d'Anthropologie de Paris*, 4ᵉ Fascicule, 1884.—The sequel to the "Anthropology of California," by M. Ten Kate.—Observations on the anthropological character and social conditions of the M'zabites, by Dr. Charles Amat, who has added to the results of his personal study of the people a brief summary of their history, derived from the chronicle of Abou Zakaria, translated by M. Masqueray, while he is indebted to a brother officer, M. Motylinsky, for much interesting information regarding the language, which differs entirely from Arabic, and presents close affinities with the dialects of the Berbers. The people, who are a remnant of the ancient sect of the Karidjites, retain many traces of pre-Moslem usages and forms of belief, follow agricultural pursuits, and are the main purveyors of corn in the Sahara.—Notes, by Dr. Hyades, on the Fuegians, considered from a hygienic and medical point of view.—On the significance of the name of the Aryans, by M. Thox, who attempts to prove its derivation from a Sanscrit root indicating "white." This hypothesis is very forcibly attacked by M. O. Beauregard, who, in a subsequent communication to the Society, brings forward strong evidence to show that the etymological meaning of the term is "noble" or "venerable."—A report on the project of instituting an official anthropometrical examination of the pupils in the primary schools of Paris, by M. Manouvrier.—On the influence of the American medium on the races of the Old World, by M. de Quatrefages.—Notes by M. Pietrement in support of his opinions regarding the age of iron, which had been called in question by M. Mortillet.—Communication, by M. de Rialle, of M. Macey's account of a grave, discovered near Saigon, Cochin China, in 1882. According to the opinion of the few natives who are versed in local archæology, this grave, which was discovered twelve feet below the surface, dates back at least 400 years. From the lower of the two superposed coffins, besides a few vertebræ and the tibiæ, a cranium was extracted which presents a deep perforation above the right temporal that may be regarded as the cause of th[e] Annamite chief to whom the remains belonge[d] M. de Ujfalvy, of the finds obtained from a C[…] near Rosegg, in the valley of the Drave. The tu[…] there are more than 300, resemble in structure an[d] teries those opened at Hallstadt and in Styria, but i[…] have yielded a large number of curious little le[…] wheels, birds, men on horses, &c., attached in […] margins of the various vases.—On some crania f[…] vingian graves at Fermes (Oise), by M. de Mar[…] extensive series of measurements, which, acco[…] afford strong presumptive evidence of diseases havi[ng …] or syphilitic origin.—On the Gallic rock-tumuli […] (Quiberon), by M. Gaillard.—On an elephant's […] the valley of the Drance (H. Savoie), by M. D'A[…] was obtained at 3000 feet above the level of th[e …] believed to belong to a relatively recent representat[ive …] *primigenius*.—On the manufacture of fire-flints [in] France, by M. P. Salmon. This industry is chie[fly …] near Percheron (Loir-et-Cher), whence large num[bers] are annually exported to supply the demand sti[ll …] them among Central African and other savage […] munication, by Dr. Verrier, regarding the work o[f …] mann, of Louisville, on the various modes of deli[very] amongst women of different races.—On the differe[nt …] resisting cold shown by various races, by M. M[…] placental anomaly in a case of twin-delivery, by D[r …] Notes on the crania of three idiots, by Drs. Bou[…] Manouvrier.—Observations on the static and dynam[ic …] by which man is enabled to stand erect, by Dr. Fa[…] searches on the so-called "Mays" of Provence, by […] Ferand. The paper is an enlarged exposition o[f …] notice, which appeared in 1883, on the Provenç[al …] our own times, in which the author sees a survival o[f …] worship of Maia—as are our own May queen, Fl[…] jack in the green, and other May festivals—the […] Christianity having modified but not obliterated t[…] paganism.

*Rendiconti del Reale Istituto Lombardo*, March 1[…] the kinetic theory of the gases and on the limits of t[he] atmosphere, by Prof. R. Ferrini.—On some geome[tri]cal, and kinematic properties of articulated polygo[ns …] G. Jung.—A comparison of the respective merits […] heliometer and the English heliograph constructed […] and Zambra, of London, by Giovanni Cantoni.—O[n …] form representations in the higher mathematical […] Prof. Giulio Ascoli.—On some remarkable featu[res …] stratified rocks in the Valtravaglia district, North L[…] Prof. Taramelli.—On the question whether rice shou[ld be con]sidered as a cereal food of man, by Leone Valari.

April 9.—Historical notes on the comet of the ye[ar …] Prof. G. Celoria.—On the geometrical movement of […] systems, by Prof. C. Formenti.—Remarks on the de[…] observed and described by Paris in his various medic[…] tions, by Prof. L. Maggi.—Further observations o[n …] representations, by Prof. Giulio Ascoli.—Note on th[e …] Roman jurisprudence in the Longobard edicts, by […] Gaudice.—Critical examination of the proposed Ita[lian …] code punishments, by E. A. Buccellati.

*Bulletin de l'Académie Royale de Belgique*, March 7.—[…] on the two Kalenoptera cast ashore at Ostend in the […] and 1885, by P. J. Van Beneden.—Observations […] comet made at the Brussels Observatory in 1870, e[…] by L. Niesten.—Observations of Lohse's comet ma[de at the] same observatory, by E. Stuyvaert.—On the early […] Flemish history, by Alphonse Wauters.—Note on […] Trelt, painter and engraver, who flourished at Ypres i[n the] seventeenth century, by Ch. Piot.

## SOCIETIES AND ACADEMIES

### London

**Royal Society**, January 22.—"Observations on t[he …]matology of Actiniæ," by C. A. MacMunn, M.A., M.D. [Com]municated by Prof. M. Foster, Sec.R.S.

The conclusions arrived at may in part be summ[ed up as] follows:—

(1) *Actinia mesembryanthemum* contains a substan[ce] which can be changed into *hæmochromogen* and *hæmatopo*[…]

above, and from
*ematin.*
by Prof. Moseley
its band occurs
Moreover, both
extracted with
into hæmochro
Actiniochrome is
not respiratory.
endoderm, and is

*Sagartia parasitica,*
exists in different
identical with that
*nacea.*
*Actinia mesembryan-*
occurs which alone
*lerdin.*
*Sagartia bellis,* yield to
mofucin, and all the
spectrum, is derived
h, which are abund
It is not identical
is proved by adding

here appears to be a
h in other species are

By John Hopkinson,

he results of experi-
considerable number of
composition, including
wrought iron, ordinary
and silicon steels. The
perties are determined
ectrical resistance. The
istance of cast iron, a
The fact that man-
erialized, and it acted
manganese appears
of steel, and in still
but not to affect the
that the observed per-
e 12 per cent. of man-
ming that this material
erial, in which are scat
particles of pure iron
s are discussed.
n Enterochlorophyll and
n, M.A., M.D.
ety in 1883, the writer
characters of [illegible]
the liver or other append
ates (hence the name). It
due to the [illegible]
[illegible]

chlorophyll in alcohol
two and the fourth in
phyll in a similar [illegible]
y meaning from the latter
e yellow constituent, which
he corresponding band
elong to a lipochrome, the
ipochrome bands of [illegible]
ponifying enterochlorophyll
in NATURE, vol. xxx. p.
able chlorophyll changes
before saponifying, [illegible]
lution after saponifying
as far as the separation
phyll yellow," are not
obtained.
chlorophyll green in solution
h nearer the violet by [illegible]
ces, the corresponding band
[illegible]
[illegible]

of enterochlorophyll disappears *in toto,* or remains in the same place. Another difference was also noted in the case of enterochlorophyll and in the case of *Spongilla* chlorophyll, namely, that it is impossible to bring about a *complete* separation of the constituents in most cases by saponifying and treating as Hansen directs.

All the bands of a solution of *Spongilla* chlorophyll are coincident with those of a similar solution of plant chlorophyll, as already proved by Prof. Lankester and Mr. Sorby.

From the enterochlorophyll of *Uraster rubens* crystals of "chlorophyll yellow" and "chlorophyll green" were obtained by saponifying.

Morphologically, enterochlorophyll occurs—as proved by the examination of fresh frozen sections—in oil globules, granules, and dissolved in the protoplasm of the liver cells; no starch or cellulose could be found in such sections after adopting the usual botanical precautions.

Hence enterochlorophyll is an animal product, and a chlorophyll, of which there are probably several occurring in animals.

**Geological Society,** April 29.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the chair.—James Backhouse, Percy Bosworth Smith, and James Shipman were elected Fellows of the Society.—The following communications were read:—On the structure of the ambulacra of some fossil genera and species of regular Echinoidea, by Prof. P. Martin Duncan, M.B. (Lond.), F.R.S., V.P. Linn. Soc. After noticing the general knowledge which exists about the structure of the ambulacra in the Cidaridæ and the elaborate investigations of Lovén on the Temnopleuridæ, the author brought before the Society the results of his own work with and without the co-operation of his fellow worker in the description of the Echinoidea of Sind, Mr. Percy Sladen, F.G.S., and which referred to the Diadematidæ and the Arbaciadæ of the recent faunas. Starting with the knowledge of the construction of the modern Diadematidæ, the author investigated the genera *Hemipedina, [illegible], Pedina, Hemicidaris, Diplopodia,* and *Cyphosoma.* The necessity for the [illegible] of the genus *Diplopodia* was shown, and a new genus, *[illegible],* was founded. *Pseudo-[illegible],* [illegible] of the forms included in these genera, remains [illegible] more from [illegible] than has been believed. The [illegible] of the [illegible] in the [illegible] plates of *[illegible]* was [illegible], and the comparison between the [illegible] plates of [illegible] and the [illegible] structure of the [illegible] plates in *Pedina* was made. The author considered that there are six types of ambulacra in the regular Echinoidea, so far as the [illegible] has been investigated, [illegible] remaining [illegible]. The types are the Cidaroid, Diadematoid, Arbacioid, Echinoid, Cyphosomoid, and [illegible]. In conclusion the succession in time of the [illegible] was [illegible].—The Glacial period in Australia, by R. von Lendenfeld, Ph.D. Communicated by W. T. Blanford, LL.D., F.R.S., Sec. G.S. Although several previous writers have suggested that localities and [illegible] found in different parts of Australia are of glacial origin, the evidence [illegible] and no clear proof of glaciation has been brought forward. During a recent ascent of the highest range in Australia, part of the Australian Alps, the author [illegible] a peak which he named "Mount [illegible]" [illegible] feet high, and is [illegible] traces of glaciation in the form of [illegible] throughout an area of [illegible] [illegible]. The [illegible] of the [illegible] were [illegible] valley named by the author the "Waldheim Valley," [illegible] from north-east to south-west, immediately south of [illegible] and the [illegible] Range. No traces of glaciation were found at less than 5800 feet above the sea. [illegible] rocks showing the action of [illegible] and the fact that the surface [illegible] has been polished by glaciers and to be proved by [illegible] [illegible] by [illegible] and [illegible] [illegible] down to the [illegible] [illegible] in [illegible] with the [illegible] and [illegible]. In conclusion the author briefly compared [illegible] of glacial action in Australia with that in New Zealand. [illegible] involved in the [illegible]—The physical [illegible] matter, by H. J. Johnston-Lavis, M.D., F.G.S., &c. The great disproportion between [illegible] of [illegible] of the same volcano at [illegible] and between the [illegible] of different volcanoes, is a [illegible] deserving the most attentive consideration. The evidence [illegible] does not bear any relation to the quantity [illegible] of material ejected. The union of water with lavas may be compared with the solution of a gas in water, but there is reason to believe that in their deep-seated sources lavas contain little or no water. If igneous matter be extruded through dry strata the eruption might take place without explosive manifestations. But if igneous matter be extruded through water-bearing beds, a kind of dialysis would take place between the igneous and aqueous masses. In this way the tension of the steam in the fluid rock may at last become so great that a fissure will be formed at the surface and volcanic action will follow. In this way the violence of a volcanic eruption will be determined by the quantity of water contained in the strata through which the lava passes in its passage to the surface, and by the temperature at which it reaches the surface. This theory explains the acknowledged sequence of volcanic outbursts of different degrees of violence, and the intervals which occur between them. It also explains the differences between the central and lateral eruptions of a great volcano and the phenomena attending its extinction. The structures of the igneous rocks, whether of basic or acid composition, are greatly modified by the presence in them of volatile ingredients. The succession of events indicated by the structure of Monte Somma and Vesuvius, Rocca monfina, Monte [illegible], and Monte Nuovo show that after a long cessation of volcanic activity we have an extensive production of fragmentary and scoriaceous material, and that this is gradually succeeded by the eruption of lava-streams. The water and other volatile substances, such as sulphates and chlorides, which are given off abundantly in volcanic eruptions, may act as solvents for the various minerals which constitute lavas.

**Physical Society**, May 9.—The meeting was held in the Physics Theatre of Clifton College, Bristol, in consequence of an invitation from the Bristol Naturalists' Society, Prof. Guthrie, President, in the chair.—Messrs. E. Cleminshaw, L. F. Henson, and A. F. Selby were elected members of the Society. The following communications were read:—On evaporation and dissociation, by Prof. W. Ramsay and Dr. S. Young. The authors gave the results of a series of investigations undertaken with the view of determining how far the passage of a liquid into a gas resembled the dissociation of a chemical compound. For this purpose the relation between the pressure and temperature of several dissociating substances such as ammonium carbamate, chloral hydrate, and phthalic acid had been examined. The authors hope shortly to publish the full details of these experiments and the conclusions arrived at.—On a model illustrating the propagation of the electro-magnetic wave, by Dr. S. P. Thompson. The model consists of two sets of beads. Each set is composed of a number of beads fixed to the extremities of wires, and by a suitable mechanical contrivance each executes an approximately harmonic motion at right angles to the wires and the mean plane of the set. The phase of each bead differing by a certain small amount from the preceding, the whole represents a wave propagation. The two sets are coloured differently and are so placed that their harmonic motions are executed at right angles about the same axis which represents the direction of propagation of an electro-magnetic disturbance, one wave being the electrostatic and the other the electro-magnetic displacement. —On a self-recording stress and strain indicator, by Prof. H. S. H. Shaw. This instrument was designed for one of Wicksteed's 50-ton single lever machines lately erected in the Engineering Laboratory of University College, Bristol, and has been found very simple and effective. In this testing machine the stress is applied by moving a mass of 1 ton along a lever; this mass is connected by a cord with a vertical cylinder upon the indicator. This cylinder carries a paper wound around it, and turns upon its axis as the mass is moved towards the end of the lever. A pencil capable of a vertical motion bears against this, and thus horizontal distances upon the paper are measures of stress. The strain is measured by the vertical motion of the pencil, the position of which is controlled by a wire attached to the rim of a wheel above, upon the same axis of which are other smaller wheels, any one of which can be connected to a fine wire which is carried horizontally to the upper end of the test-piece passing over a pulley fixed to it, and is fixed to the lower end. Any extension of the test-piece can be multiplied at pleasure on the diagram by attaching the wire to a larger or smaller wheel.—Note on the so-called silent discharge of ozone generators, by Mr. W. A. Shenstone. Mr. Shenstone had arranged some apparatus by which this could be viewed. It seemed to have the characteristics of the Brush discharge.

EDINBURGH

**Royal Society**, April 20.—Robert Gray, Vice-Pre[illegible] the chair.—In a paper on the effect of pressure on the [illegible] ture of minimum compressibility of water, Prof. Tait [illegible] that the various results obtained admitted of easy deduc[illegible] theory.—A note on the variation by pressure of the [illegible] point of paraffin, &c., by Mr. W. Peddie; and a no[illegible] thermal effects of tension in water, by Mr. G. N. Stew[illegible] submitted by Prof. Tait.—Mr. Hugh Robert Mill read [illegible] on the temperature of the water in the Firth of Forth, d[illegible] the work done at the Scottish Marine Station in this c[illegible] The annual range of temperature, from summer max[illegible] winter minimum, was found to vary from nearly 40° F. [illegible] where the river is fresh at low tide, to 20° at Queensferry [illegible] to seaward, and to [illegible] the mouth of the Firth thirty-[illegible] further on. The mean temperature of the water appear[illegible] the same—47°.5—at all parts of the estuary. From [illegible] September the river was warmer than the sea, from Oc[illegible] May it was colder, the average rise or fall in temperatur[illegible] time along the Firth being 0°.07 per mile. During the [illegible] period the surface-water had a higher, and during [illegible] lower, temperature than that beneath. The annual m[illegible] was reached in February, the maximum in August, a[illegible] were mean at [illegible] of the period being delayed toward th[illegible] sea. Materials are unfortunately wanting for discuss[illegible] variations of temperature in the North Sea beyond the [illegible] of [illegible]. Mr. Mill showed curves of the monthly me[illegible] peratures of the water plotted by the use of polar coor[illegible] Each month was represented by an angle of 30°; the [illegible] being [illegible] on the radius. Equal values were d[illegible] concentric circles. Temperatures so plotted appear as [illegible] curves, and in several cases those for the water resembled [illegible] placed [illegible] to the circle of reference. This m[illegible] curve-drawing has several advantages over that by the [illegible] rectangular coordinates where periodic phenomena are [illegible] represented.—Mr. J. T. Cunningham, of the Marine Statio[illegible] a paper on the relations of the yolk to the gastrula in tele[illegible] and in other types.

**Mathematical Society**, May 8.—Mr. A. Y. G. [illegible] President, in the chair.—Prof. Chrystal read papers on [illegible] differentiation, and on a process for finding the differentia[illegible] tion of an algebraic curve. Dr. Thomas Muir made [illegible] mnemonics on [illegible], and gave a historical [illegible] the so-called Simson line. Mr. J. S. Mackay contributed [illegible] mnemonics for certain mathematical constants.

SYDNEY

**Linnean Society of New South Wales**, Feb. 25.—P[illegible] J. Stephens, M.A., F.L.S., President, in the chair.—The [illegible] ing papers were read:—On some reptiles from the H[illegible] River [illegible] Queensland, by William Macleay, F.L.S. [illegible] Five new species are here described: *[illegible]*, and *[illegible]* of the family Scincidæ, and of Oph[illegible] *[illegible]*, *[illegible]*, and *[illegible]* [illegible] Coleoptera, described by th[illegible] Francis Walker, by A. Sidney Olliff. In these notes Mr. [illegible] who had examined Mr. Walker's types in the British Mu[illegible] endeavours to clear up the synonymy of the Ceylonese [illegible] The name [illegible] was proposed for the *[illegible]* of Walker, which cannot be referred to any known genus [illegible] form [illegible] *[illegible]*, but is characterised by the pre[illegible] of a scutellum.—On the flight of birds, by R. von Lende[illegible] Ph.D.

PARIS

**Academy of Sciences**, May 11.—M. Bouley, Preside[illegible] the chair.—Remarks on the application of photography [illegible] mapping of the stars by means of MM. P. and Pr. He[illegible] new objectives, by M. Mouchez. The first essays with [illegible] objective of 0.16 m. and a provisionary apparatus proved so [illegible] cessful, that a new instrument has been constructed with [illegible] objectives of 0.24 m. and 0.34 m. respectively. Althoug[illegible] yet completely regulated, this instrument has already yi[illegible] some remarkable results, fully justifying, if not exceeding [illegible] hopes entertained by astronomers. It appears to have one [illegible] all solved the problem how to apply photography to the [illegible] struction of a map of the heavenly bodies which shall in[illegible] stars of the 14th and 15th magnitudes.—On the spontane[illegible] reversible spectral rays, and on the analogy between the la[illegible]

[illegible] of the hydrogen ray, [illegible] tibility of solid mer[illegible] es, by MM. Cailletet [illegible] made with mercury, [illegible] and platina, [illegible] istance of most pure [illegible] nature is lowered from [illegible] ariation is apparently [illegible] le that the resistance [illegible] peratures lower than [illegible] en practically tested [illegible] hloride of aluminium, [illegible] quiry into the reason [illegible] of bringing into play [illegible] per, by M. Vulpian. [illegible] de Saporta's [illegible] M. Duchartre [illegible] ation at great distances [illegible]

[illegible]

analyses of the Mont[illegible] waters between Florence and Pistoja, by M. [illegible] On an arrangement enabling the observer to follow with the eye the phenomena presented by aquatic animals subjected to a pressure of [illegible] atmospheres, by M. P. Regnard. — On a new apparatus intended to detect infinitesimal quantities of [illegible] present in fluids or in solid substances, and termed the "[illegible]scope" by the inventor, M. M. de [illegible] — On [illegible], by M. A. Villiers. — Note on a method for measuring [illegible] of sensations, and especially those of colour, by M. Aug. [illegible] — On the formation and development of the [illegible] or *C[illegible]*, by M. A. [illegible] — [illegible], by M. A. [illegible] — Remarks on the [illegible] of a new epidemic recently [illegible] in the neighbourhood of [illegible], by M. A. [illegible], which [illegible] with [illegible], was ultimately traced to the leaves of the [illegible], the varnish of Japan, growing in th[illegible] and [illegible] by the[illegible] birds.

[illegible]

**Physiological Society**, [illegible] Prof. [illegible] spoke on [illegible]

[illegible]

poison belonged to the class of propeptones. Experiments were instituted with representatives of all the vertebrata. They were all susceptible of the poison, and died when the dose of the poison amounted to 3mg. per kilogramme animal. The time when death followed a full dose of the poison was very various. Rabbits died after half an hour, pickerels after an hour, frogs later, then cats, and lastly pigeons. Stronger doses hastened death. Dilutions and the introduction of artificial respiration delayed death. The physiological effect extended principally to the central nervous system. The muscles and the peripherical nerves continued irritable, although paralysis set in very soon. Seldom were spasms and convulsive movements observed. The poison appeared to have hardly any effect at all on the heart.

**Physical Society**, April 24.—Dr. Kayser reported on a recent paper of Prof. Bunsen (*Wiedemann's Annalen*, 1885, Heft 3) in which the differences between the results of the speaker's experiments regarding the absorption of carbonic acid on smooth glass surfaces and those published by Prof. Bunsen two years ago received their explanation. While, namely, Dr. Kayser had found that the absorption of carbonic acid proceeded according to definite laws formulated by him, Prof. Bunsen had observed that this process of absorption did not terminate even after as long a period as three years, but still continued, even though at a reduced rate. In his most recent work Prof. Bunsen had now established that the glass threads, even after a current of dry air had been for a considerable time directed over them, still retained a layer of water which was thin in proportion as the temperature was high, but did not become entirely dissipated till the temperature reached as high as about 500° C. This layer of water it was which absorbed the carbonic acid, and all the more powerfully the denser was the layer of water. The density of the water, however, stood in inverse relation to its thickness. From these experiments Dr. Kayser concluded that the absorption of carbonic acid on the glass threads which Prof. Bunsen had observed continuing for so long a period was only an absorption of the gas by the adhering water and no absorption on the smooth glass surface, whereas in the speaker's experiments, in which the glass threads had in boiling oil been freed from all adhering matters, the carbonic acid had been absorbed by the smooth glass.—Dr. Less spoke of two curves placed before the Society, as markings of the barograph on April 22 and 23 during the time of the brief thunderstorm in Berlin. The two curves presented in general an analogous course, concurring, moreover, with curves which Dr. Less had observed last year during the severe July storm. Before the outburst of the thunderstorm the curves sank slowly, next rose steeply to a considerable height; with the attainment of the maximum of pressure coincided the stroke of lightning; the curve then maintained itself at a level for some time, throughout which the thunder-shower or hail was wont to fall; on the cessation of rain the curve of atmospheric pressure sank steeply to beneath the former minimum. In the two April curves a further sudden rise preceded the second weaker stroke of lightning, and there then followed several smaller jerkings of the curves coinciding with the time of the formation of clouds consequent on the short thunder-storm. In the curves of the July of last year during the severe storms so copiously charged with lightning, the apex of the curves after the sudden ascent was not straight, but consisted wholly of short indentations each of which appeared to correspond with an individual lightning stroke, so far as it was possible to fix the precise times. The sudden steep ascent of the curve on April 22 and 23 coincided with a sudden increase in the force of the wind, which soon, however, fell weaker, and at last sank almost to complete stillness. The speaker also reported the corresponding numerical values for the variations of atmospheric pressure marked by the barograph.

VIENNA

**Imperial Academy of Sciences**, March 5.—Contribution to a knowledge of Coniopterygidæ, by F. Lowe.—On a new morphological element of peripheral nerves, by A. Adamkiewicz.—On the sensibility to light and colours of some marine animals, by V. Graber.—On some propagatory organs of the fossils of Conjuolita, by M. Kornfeld.—On the fauna of the Jurassic deposits of Hohenstein, Saxony, by G. Bruder.—On mannite deposits of [illegible] lead nitrate, by A. Smolka.—Note on Lowe's lead-nitrate and lead nitrate, by A. Smolka.—Note on the temperature of Vienna and its environs, with a study on the action of local influences on the mean temperature, by J. Hann.—On camphoronic acid, by T. Kachler and F. V. Spitzer daily and yearly course, and on the period of distu magnetic declination at Vienna, by T. Liznar.

March 12.—On nerve corpuscles, by A. Adamkie the use of boiling oxygen, nitrogen, carbon oxide, a spheric air as a freezing-agent, by S. von Wroblewski bution to a knowledge of the texture of hyaline cartil Zuckerkandl.—On the Upper Italic flora of the Lunz of the bituminous slates of [illegible], by Dr. Stur.

March 19.—Crystallographic researches on camphor by V. von Zepharovich.—Experimental studies on t mination of the constant of dielectricity of some vapours, by T. Klemencic.—On the planes of solutio calcareous spar and aragonite, by V. von Ebner. O [illegible] by corroding aragonite, by the same.—On explosion observed at a distance of 1000 metres by R on March 13, by J. We[illegible]

[illegible]

**Society of Sciences**, April 17.—The following Dr. K. H. J. Forssell, was accepted for insertion Society's *Journal*: "Beiträge zur Kenntniss der Anat Systematik der Adoxaceen" Prof. Lilljeborg des *Macrodon arcuatus* (Bloch) taken in the Atlantic (lat. 54° 5' S.), and suggested that it was probably fo both sides. It was taken by Capt. Scheele, of the barque *Monark*, an amateur scientist to whom the So lent instruments, vessels, and apparatus for deep-sea res He further exhibited *Eurosma* [illegible] (Lubbock), al by Capt. Scheele in the South Atlantic. It was remar having an appendage or eye on the side of the head Hildebrandsson spoke about the twilight phenomenon, with reference to some observations of the purple glim prevailing, made by Dr. Gyllenskold.—Prof. Clason lecture on the functions of certain parts of the brain.

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# NATURE

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*"To the solid ground*
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## ZOOLOGICAL SOCIETY OF LONDON.

DAVIS LECTURES, 1885.

A Series of Lectures upon Zoological Subjects will be given in the Lecture-Room in the Society's Gardens, in the Regent's Park, on THURSDAYS at Five p.m., commencing June 4.

| DATE | SUBJECT | LECTURER |
| --- | --- | --- |
| 1. Thursday, June 4 | Rhinoceroses and their Extinct Allies | Prof. FLOWER, LL.D., V.P.R.S. |
| 2. ,, ,, 11 | Apes and Lemurs | Dr. ST. GEO MIVART, F.R.S. |
| 3. ,, ,, 18 | The Structure of the Swan | Prof. W. K. PARKER, F.R.S. |
| 4. ,, ,, 25 | The Domestic Cat | J. E. HARTING, Esq., F.L.S. |
| 5. ,, July 2 | Recent Advances in Zoology | Prof. F. JEFFREY BELL, M.A. |
| 6. ,, ,, 9 | The Ancestors of Birds | F. E. BEDDARD, Esq., M.A. |
| 7. ,, ,, 16 | The Animals of New Guinea | [illegible] |

These Lectures will be free to Fellows [illegible] and to other Visitors to the Gardens.

[illegible] Secretary.

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THURSDAY, MAY 28, 1885

## PRACTICAL INSTRUCTION IN BOTANY

*A Course of Practical Instruction in Botany.* By F. O. Bower, M.A., F.L.S., Lecturer on Botany at the Normal School of Science, South Kensington, and Sidney H. Vines, M.A., D.Sc., F.L.S., Fellow and Lecturer of Christ's College, Cambridge, and Reader in Botany in the University; with a Preface by W. T. Thiselton Dyer, M.A., C.M.G., F.R.S., F.L.S., Assistant Director of the Royal Gardens, Kew. Part I. Phanerogamæ-Pteridophyta. (London: Macmillan and Co., 1885.)

IT is with more than ordinary satisfaction that we welcome this volume. Apart altogether from consideration of its intrinsic excellency, its appearance is gratifying as a first product of the younger school of botanists in this country—a school which for some years past has been doing good work in oral teaching, though up till now it has not contributed to teaching literature—and it is time that its methods were put in a more permanent form and made more generally accessible. The inconsistencies and inaccuracies characterising, with few exceptions, our endemic botanical text-books and our dependence for reasonably safe handbooks with information up to date upon translated works, mostly of German authors, are a reproach for which every botanist would gladly see the cause removed. At last we have a prospect of this, and the volume now before us is an instalment of a work which will in great part do so. The names of Thiselton Dyer, Bower, and Vines on the title-page are a guarantee of its thoroughness and accuracy, and the book certainly bears out their reputation.

The book took origin, as Mr. Thiselton Dyer informs us in the preface, in the work initiated by him at South Kensington in 1873. It is no small merit to have started at that time a system of instruction which embraced the examination by every student of the leading morphological facts of every important type in the vegetable kingdom. And this programme, which Mr. Thiselton Dyer set himself and successfully carried out, has not only eventuated in what, with him, we hope will be permanent—the institution, in what is now the Normal School of Science, at South Kensington, of a lectureship on botany, but also, in what concerns us here—this volume.

"I had always," says Mr. Thiselton Dyer, "hoped to put together the results of the experience in teaching methods acquired at South Kensington in the form of a handbook, which should save teachers who wished to follow our example from much of the trouble and difficulty which I, and those who at different times have taught in this way, have had to face. But, in the meanwhile, I had been drawn off to administrative duties which left a steadily decreasing leisure for purely scientific work. Fortunately, my friend Mr. Bower was willing—and with far greater competence—to take up the task which I was unable to perform, and to him are entirely due the laboratory instructions for studying the different types selected. Dr. Vines has very kindly supplied the chapters on methods and on the morphology of the cell. But besides this he has at every step given the assistance of his own extensive experience in practical teaching." With this book before us we can understand the motive of success of the South Kensington course, for it is the most thorough introduction to the practical study of plant morphology which has yet appeared; the only book to be mentioned along with it is the recently published "Practicum" of Strasburger—(of which of course the inevitable translation is promised)—and that is laid down on somewhat different lines.

In the first chapter Dr. Vines gives an excellent account of methods and reagents, delightful in the clearness and conciseness of its language and bearing throughout evidence of the hand of one who is no mere compiler of instruction but who has himself tested and had experience of all that is explained. The manner of setting to work, of making preparation, of making cultures, of preparing reagents, is all set forth in such a way that any intelligent tyro may readily equip himself and do good work. And we must congratulate Dr. Vines on the wise selection of methods and reagents he has made for notice, and on their arrangement. The multiplicity of new methods—many with but questionable advantage to recommend them—and their technicalities even in connection with botanical work is, at the present time, somewhat appalling and it is satisfactory to have these sifted by so competent an authority.

Dr. Vines's second chapter, on the Structure and Properties of the Cell, is a very prominent and commendable feature in the book, and will prove an extremely valuable one to all practical students—the micro-chemical portion of it especially, which gives in summarised and terse form the fundamental reactions exhibited by the various elements in the plant body, which are the basis of all further laboratory work. The student finds here at once a guide for testing the dictums of the earlier chapter as well as a graphic code for reference in his future studies. A synoptical arrangement such as this, and so happily worked out, has not been attempted in any previous book.

Mr. Bower's more especial work, the morphology of the various types dealt with, is no less excellent. The examples selected for illustration appear to us particularly well chosen, being readily obtainable in any locality, and their characteristics, macroscopic and microscopic, are explained with precision and in great detail. We shall not dwell at any length upon illustration of the admirable character of this part of the book, but in evidence of its completeness will refer to the section on the vegetative organs of Dicotyledons. *Sunflower* is selected as the chief type for examination, and we have first of all a brief description of the embryo and germination; then its stem in the mature and young condition are gone over, macroscopically and microscopically; but as it shows only the herbaceous type, the arboreous type as seen in *Elm* is explained, and further, the aquatic type, as in *Mare's tail.* Sections are next added on the stem of *Cucumber* and *Lime-tree* with a view to special illustration of the sieve-tube elements, and upon *Dandelion* and *Spurge* for laticiferous elements. In like manner the leaf is treated of, to that of *Sunflower*, which is the chief type, descriptions of *Cherry-laurel* and *Stone-* being appended. Again, in the case of the root, *S* *runner* as well as *Sunflower* is described. Beside [illegible] mentioned, which are dealt with in detail, [illegible] references are made to other examples in which [illegible] or further illustration of special features may be [illegible]. Similar thoroughness runs through the accounts of all the types.

Every one perusing the volume must be impressed with the high standard of its educational value. Teacher and student in this country are alike to be congratulated upon its publication. The former has now a thoroughly trustworthy laboratory guide to place in the hands of pupils, and the latter has a handbook in his own language to which he can refer with confidence in his search after a sound knowledge of plant morphology.

This is only the first part of the work, and deals with Phanerogams and Pteridophytes. May the succeeding portion not be long in appearing! It is regrettable that the original intention of the authors "to preface the directions for the study of each type with a short account . . . of its salient morphological facts" has not been carried out in this part; Mr. Thiselton Dyer assigns in the preface the reason for its postponement. We are convinced that the want of such brief epitomes will be universally felt. But as the book is certain of a full measure of success, we look forward, with the authors, to the realisation of their hope that "the original scheme upon which the work was planned" may be "carried out in a future edition."

We conclude as we began by heartily welcoming the volume. We envy a student commencing to work with such a guide, and we are greatly mistaken if its effect is not very rapidly felt in the botanical teaching of the country.

## THE PENNATULIDA OF THE NORWEGIAN NORTH ATLANTIC EXPEDITION

*Den Norske Nordhavs-Expedition, 1876–1878. Zoologie. Pennatulida.* [illegible]

T[illegible]

[illegible]

polyps being barren. They are viviparous, the larvae escaping from their mouths, as in Corallium. The other new genus, Gunneria, is founded on a fragment of a single specimen, but it is characterised by the presence of an immense quantity of spicules on the bodies of the polyps, their tentacles, and the sarcosoma, which latter forms a regular calcareous crust on the walls of the cells; the spicules are so closely packed in several layers that it is difficult to separate them, even with caustic potash. In this respect Gunneria approaches the Gorgonidae; yet it is, nevertheless, a true Pennatulid.

The main feature of the memoir is, however, the part which relates to the now famous deep-sea [illegible] *Umbellula encrinus*, to which more than half the letterpress and seven of the [illegible] plates are devoted.

The Norwegian Expedition obtained twelve specimens of *Umbellula encrinus* from different localities. Kölliker described eight species of the genus from the [illegible] collection, but one of these, *U. [illegible]*, is considered by the authors as referable to the old historical *U. encrinus*, as are also Lindahl's new species from the Swedish Expedition of 1871, viz. *U. [illegible]* and *U. [illegible]*. The whole of the twelve specimens obtained by the Norwegian Expedition are here carefully described in all details. All of them differ from one another, showing peculiarities in various ages and stages of development which might, were the series less complete, easily lead to the establishment of separate species. The largest specimen obtained was dredged from a depth of [illegible] metres. It is a giant indeed. The rachis and the polyps, of which there are forty in the bunch, are twice figured on the last two plates, of actual size, coloured and uncoloured. The bunch of polyps occupies with its breadth nearly the entire length of the folio plate. The plates are far the finest representation of Umbellula yet published. There are eight prominent lanceolate areas occupied by zooids which extend up between the lateral polyps on the calicle-like part of the rachis, and spread themselves inferiorly over the rachis generally. The zooids are described as having each a single protusible tentacle, the tentacle when not retracted looking like a pendent papilla. These tentacles sometimes, but not always, bear short lateral pinnules, which are hollow, their cavities communicating with those of the tentacles, and which can be retracted with them. Kölliker, in his account of the *Challenger* Pennatulids, described similar zooids each bearing a single tentacle as existing in *Umbellula Huxleyi* and *U. Carpenteri*, and in the latter species found the single tentacles branched. He figures them, but only on a very small scale. On looking at the figures here given of these zooids (Tab. X., Figs. 56, 57) it is very difficult to understand their structure: the position of the mouth is not shown in any one, and they are drawn as elongate and flask-like in form when expanded, squat and rounded when retracted. The tentacle seems when protruded to be a direct narrow prolongation of the entire body of the zooid, and it appears as if on retraction this prolongation were telescoped into the basal region of the body. The base of the single tentacle should abut on one side of the mouth, but no such mouth-opening is figured. In the enlarged view of a zooid (Fig. 57) the mouth is neither definitely indicated nor referred to in the description. The text is not at all clear on the point.

The polyps bear the gonads, and are apparently viviparous. Very interesting conclusions are arrived at by the authors by comparison of the various stages at their disposal as to the mode of growth and successive additions of fresh polyps to the colony around the terminal primary polyp, and these are at variance with those of Lindahl. A couple of lateral polyps appear on each side of the terminal polyp, then another pair of laterals are formed, and the rachis expands in breadth. The centro-dorsal polyp is formed, and then the dorso-lateral are developed, whilst the lateral polyps become more numerous.

H. N. MOSELEY

## OUR BOOK SHELF

*A Flora of the English Lake District.* By J. G. Baker, F.R.S., F.L.S. (London: George Bell and Sons, York Street, Covent Garden, 1885.)

IT is perhaps surprising that a "Flora" of the Lake district has not before been issued, considering the large number of botanists who have yearly rambled over its fells and dales. It has been left to Mr. J. G. Baker to do so, and with modesty he says "it does not seem likely at present to stand in the way of anything more complete." The limits of the "Flora" embrace parts of Cumberland, Westmoreland, and the whole of what is botanically called Lake Lancashire; but excludes "the northern half of Cumberland and the western slope of the Pennine Chain, through Cumberland and Westmoreland;" the exact boundaries are, however, not very clearly defined

One cannot help feeling, directly the book is opened, that it is the work of one used to generalise and deal with facts in a broad way: in no part more so than in the first fourteen pages, where, accepting Mr. H. C. Watson's definitions, he describes the distributive types, zones of altitude, temperature, &c., with a clearness coming of long and practical acquaintance with the subject, giving comparative tables of the types, &c., with those of Northern Yorkshire, Northumberland and Durham, and Britain, and making the Lake Flora about 900 species. It should, however, be remembered that this number is based on Mr. H. C. Watson's estimate of 1425 species for Britain as a whole.

Had that estimate to be made *now* by Mr. Watson, the result would probably be the accepting of a larger number, not alone by the discovery of species since made, but by a decided feeling on his part "that there were some species that would eventually have to be divided." It may well be asked *why* is there this comparatively large amount of difference demanded among our native plants to constitute a "species," and the little often accepted among newly-discovered "species" from distant countries; doubtless knowledge is progressive in the latter case, but still theories and generalisations are built up on them with as much apparent certainty as on floras long known and studied. Mr. Baker then enumerates the species constituting the flora, running up to 234 pages, numbering them according to the sixth edition of the "London Catalogue," showing also (but not numbering) the large number of doubtful plants that have at various times been reported from the district.

Perhaps the most striking fact brought out by this "Flora" is the scarcity of aquatic species compared with the numerous lakes and tarns, of which there must be between sixty and seventy, large and small. Whether in this particular district this is from the want of investigation, or from a real paucity of species or specimens, is difficult to say; but certainly our lakes and waters have not been sufficiently systematically searched, whether from the botanical, zoological, or chemical point of view. In this we should do well to emulate the Swedish naturalists; but in *our* case it may well be asked, "Where are we to look for help?"

How little we know of the life-histories of our aquatic plants! and it may well be suggested as a study for those botanists, who, while not being able to take up botany in the way so ably advocated lately by Prof. Bower in NATURE, still have some leisure from other occupations and duties, and could really advance the knowledge of our flora beyond mere collecting. It is only necessary to turn over the plates of Dr. T. Irmisch's work on them to understand what is meant and required.

AR. B.

*The Fallacy of the Present Theory of Sound.* By Henry A. Mott, jun., Ph.D., E.M., &c., Professor of Chemistry and Physics in the New York Medical College and Hospital for Women; Author of "The Chemist's Manual," "Was Man Created?" "Adulteration of Milk," "Testing the Value of Rifles by Firing under Water," "The Laws of Nature," "The Air We Breathe and Ventilations," &c. 12mo. (New York: Printed for the Author, 1885.)

THIS is a very curious book. Its author appends to his name recognised scientific titles, and seems to hold a responsible position as a teacher; but he has been led into a hopeless and inextricable muddle about wave-motion; and, starting with a misconception, he naturally obtains results so utterly at variance with common sense and experience, that it is remarkable he cannot see his error.

He begins by admitting that "to attack a theory which has been upheld for 2500 years, and which has been and is sustained by the greatest living scientists, is certainly a very bold undertaking." But he feels bound, nevertheless, "to come to the front and join Dr. A. Wilford Hall in exposing the fallacy." He fulminates, moreover, the following withering defiance at false prophets: "If Profs. Helmholtz, Tyndall, Lord Rayleigh, Sir William Thomson in Europe, and Profs. Rood and Mayer in this country, wish to retain the respect and confidence of thinking people, they will at once endeavour either to defend the theory of sound, or, like men, come boldly to the front and acknowledge that it is fallacious."

There can be no doubt that these various noblemen and gentlemen will at once proceed to adopt humbly the latter and safer alternative; because it is obvious that if they do not do so speedily, creation and nature will come to a premature end. This rather serious occurrence is thus predicted: "The lowest tone of an organ is stated by Prof. Blaserna to have sixteen vibrations to the second, and a consequent wave-length of 70 feet. It thus follows, says Dr. Hall, that in the sound of such an organ-pipe the air-particles (as a whole) are obliged to travel 35 feet and back sixteen times each second in order to pass from the space occupied by the centre of rarefaction to the centre of condensation and back. They would thus move with a velocity in one direction of 560 feet a second, or at the rate of 381 miles an hour, which would produce a tornado of more than double the velocity necessary to sweep a village into ruins. If there was the least truth in the wave-theory, the sound of a church-organ should get up a cyclone which would blow a cathedral into atoms."

This is truly very horrible! far worse than dynamite. Saddened by these reflections, we can bear with comparative equanimity the revelation that "the prong of a tuning-fork moves at the rate of only about one inch in four years," and "instead of swiftly advancing, as Tyndall says, sounds audibly when moving more than 25,000 times slower than the hour hand of a family clock, and more than 300,000,000 times slower than any clock-pendulum ever constructed, instead of very much faster, as Helmholtz teaches."

One more quotation is irresistible: "Imagine," say our author, who seems to have recovered wonderfully the terrestrial cataclysm which he and the evi

iite different notation is employed—is simply infuriating! I ould urge upon Prof. Pearson that he has now an unrivalled pportunity of fixing in the language of English (and perhaps reign) mathematicians a really serviceable and significant stem of notation.

The double-suffix notation for strain and stress, which is deveped to perfection in St. Venant's French translation of Clebsch, as many advantages, but seems to be too cumbrous for English ste. Nothing perhaps could be more unmeaning than Thomson nd Tait's notation for "stresses," independent as it is of all eference to the strain-symbols. Still I must confess (in common, dare say, with most men who have derived their first inspiraons from that mathematical epic) that it has secured too firm a lace in my mental machinery to be lightly cast out, even in avour of a better. W. J. IBBETSON

Cambridge, May 12

## The Colours of Arctic and Alpine Animals

MR. R. MELDOLA has maintained, in NATURE, vol. xxxi. p. 505, the idea that the white colour of some animals, Arctic mammals and birds, must be ascribed to the absorbent and radiating power of the same colorations in relation to the rays of the sun. He maintains also that to a similar cause we owe the seasonal polychromism of several mammals and birds of the Alps, and what would be for these animals a partial return to the characters of the Glacial epoch.

By an analogous theory the author explains the contrary phenomenon that is observed in many insects—that is, the darkening of the coloration, and he speaks principally on this point of the Lepidoptera.

Now I beg to make the following observations, and to indicate the following facts:—

(1) That a seasonal mutation of colour is observable in many mammals, now more, now less distinctly, and generally it concurs with the change of coat. Also not seldom in mammals strictly belonging to the Alps, as, for example, in the *Rupicapra europea*, and in the *Capra ibex*, the colour changes very little in the summer and in the winter, although the length, the thickness, and also the coarseness of the hairs were very different. In other cases, as, for example, in the *Cervus mandarinus*,[1] the coat is, in summer, light reddish yellow, with many round white spots, while in winter it is dark brown, and the round spots are less numerous and are light brown.

(2) As to the insects, it is observed that in *Coleoptera* the colours of the Alpine species are brighter than those of the warmer plains, as in the genera of *Carabus*, *Pterostichus*, &c. In several species of *Harpalus*, *Amara*, *Cicindela*, &c., the individuals that we find at the greatest elevations of the Alps have often lighter colours.

(3) A darker colour and sometimes a whole melanism is observed in general in the insects of the deserts—for example, in that of Sahara. On the contrary, the mammals of these countries present in general a very light colour. It seems to me that this fact cannot be explained by the theory of radiation.

(4) A very remarkable melanism is also observed in several mammals, the Reptilia and Coleoptera that are in little islands, or upon rocks in the warmest regions, for example the *L. muralis*, &c., *Cicindela campestris*, in the island of St. Peter in Sardinia.[2]

(5) In the reptiles and in the Alpine amphibia we sometimes meet with some cases of darkening, but the cases of a remarkable brightening are not very rare, as, for example, in the *tadpoles* of *Rana muta*.

(6) A sensible difference is observed in the coloration between the Arctic birds and the Antarctic. In these last black is much more abundant.

Indeed, Australia, New Zealand, &c., are countries known for a remarkable darkening in the colours of many sorts of animals.

In the Carnivora, which are the mammals that chiefly present seasonal polychromism and white colour, is observed a tendency to this colour in several forms that, however, do not live either in Polar regions or in very cold places. As to this fact the colour of the genera *Zorilla*, *Mus*, &c., and also the very curious *Ailurus melanoleucus* of Thibet,[3] should be observed.

[1] Milne-Edwards, "Recherches pour servir à l'Histoire Naturelle des Mammifères," tav. 22, 1868. Paris: Masson.

[2] Si consulti L. Camerano, "Ricerche intorno alla Distribuzione dei Colori nel Regno animale." *Mem. R. Accad. Scienze di Torino.*

[3] Milne-Edwards.

The causes, I would say in conclusion, that intervene to modify the colour of animals, are very complicated; climate has amongst these a certain importance, but it does not seem to me that, although it be very attractive, Mr. Meldola's theory of radiation is sufficient. LORENZO CAMERANO

Zoological Museum of Turin

## On Certain Stages of Ocular After-Images

IN a short note in the *Phil. Mag.*, 1872, vol. xliii. p. 343, Prof. C. A. Young has recorded a curious instance of "after-image," which seems to me to be of the same order as that observed by Mr. Shelford Bidwell, and recorded in NATURE, (vol. xxxii. p. 30). I quote from Prof. Young's note, which is named "Note on Recurrent Vision," a few lines, which will show what his observation was:—

"In the course of some experiments with a new double-plate Holtz machine belonging to the College (Dartmouth, America), I have come upon a very curious phenomenon, which I do not remember ever to have seen noticed. The machine gives easily intense Leyden-jar sparks from 7 to 9 inches in length, and of most dazzling brilliance, at the rate of seventy a minute. When, in a darkened room, the eye is screened from the direct light of the spark, the illumination produced is sufficient to render everything in the apartment perfectly visible; and, what is remarkable, every conspicuous object is seen *twice* at least, with an interval of a trifle less than a quarter of a second—the first time vividly, the second time faintly; often it is seen a third, and sometimes (but only with great difficulty) even a fourth time."

Prof. Young shows that it is a subjective phenomenon, and measures the interval between the first and second seeing of an object, giving as the mean of twelve experiments the interval 0·22 second for the case of his own eyes, and 0·24 second for that of another observer.

Five or six years ago I observed another instance of what I believe to be the same kind of "after-image," though at first I was inclined, being engaged upon experiments with a view to finding the cause of certain ocular "ghosts" due to multiple reflection inside the eye (*Proc. Roy. Soc.*, No. 223, 1883), to ascribe it to a different cause. It was seen in a room lighted only by the bright glow of coals in the grate. Whenever the eyes were suddenly flashed across the fireplace, and then fixed on some object 50° or 60° from it, there appeared a faint blue light, which seemed to flash from the object to the glow. This phenomenon was much more strongly marked at some times than others, and varied with some cause which I never further investigated. Later I came upon another instance of the same thing; and as this is the easiest to reproduce, and one by which one may best study the phenomena, I will describe it.

Let a match or a splinter of wood be made to glow, as for testing oxygen, and let it be observed in a dark room; the eyes should be fixed, and the glowing match moved about. I found that for purposes of rough measurement a most convenient curve of motion is a figure of 8 on its side in a vertical plane (∞). Also it is convenient to keep the period of the movement the same, and to vary the size of the curve if change of velocity is required. There are difficulties to be overcome in regulating the brilliancy of the light (Mr. Bidwell has pointed out the necessity of a certain degree of brilliancy in the case of the vacuum tubes, if a systematic investigation were undertaken; a glowing match becomes brighter the quicker the movement; the reverse is the case with a platinum wire carrying a strong current of electricity; and a small incandescent lamp is objectionable on account of reflection from its glass case.

I shall consider the "after-images" of the glowing-point as forming a trail, in which all the changes are set out at the same moment, and proceed to describe the trail for two cases. I should state that following descriptions refer to the trails as seen by me *in the evening*; for there are very considerable variations in the phenomena according as the eye is likely to be wearied or fresh. I may also repeat Mr. Bidwell's caution that it is by no means certain that a person new to the subject will at first be able to see the appearances described.

I arrange a metronome beating seconds, and move the glowing-point so as to describe the curve completely in two seconds. First, let the figure of eight be only as large as can be got into a rectangle 3 inches by 1½. In this case there comes after the glowing-point a dark interval in the trail, about an inch long; then a distinct blue-green ghost, about the same size as the glowing-point; again a dark interval follows, shorter than the first, and behind it a long strip with a dark core and very faintly bright edges; as one traces backwards, the edges appear to close in together gradually, so that, after about two inches, the dark core has collapsed, as it were, and the edges have come together to form a narrow and well-defined thread of a mauve tinge; this gradually dies away as we go further back along the trail, and by the time that the glowing-point has travelled over the whole curve once, it has nearly disappeared.

Secondly, let the figure of eight be as large as can be described in a rectangle 8 inches by 4. Here the phenomena are quite different. It now seems as if the dark intervals at either end of the ghost as described above were absent, and the ghost itself were drawn out into a streak which follows *immediately* upon the glowing-point. Its colour is now yellow-green. This gardually narrows to extinction as one traces the trail backwards, and is the positive after-image in its various stages. More probably this streak has no connection with the true *ghost*; but is quite distinct from it, whilst the ghost no longer appears, when the point moves with greater velocity. In fact, there is probably a limiting velocity of the glowing-point, beyond which the ghost is not formed. This coincides with Mr. Bidwell's observations as to the rate of rotation of the vacuum-tube. As the yellow streak disappears narrowing, one sees a faint blue haze on either side, separated from it by an interval of darkness. When one has traced backwards so far that the streak has vanished, one sees what was above described as a strip with dark core and faint blue or mauve edges. The edges close in and form a distinct mauve thread, which gradually dies out.

It is very beautiful to see the ghostly trail hanging before one; and, by suitable movement of the glowing point, one may fill the space, as it were, with a maze of wreathing lines. Perhaps the most striking part of the phenomenon, regarded from an æsthetical standpoint, is the *depth* of the figures so produced: one realises in the form of the trail that the glowing-point has been moving, not in one plane, but in space; and one sees that some parts are nearer than others. After a time the glowing-point seems to be forgotten, and the trail is the only thing observed. The position of the trail appears to change with any change in the state of accommodation of the eye; if the trail goes away from one the eye attempts to follow it, and exaggerates the movement. If there is any irregularity in the curve, as may often be the case from want of proper co-ordination of muscles—especially if the moving arm is at all subject to rheumatism—it is revealed in a terribly truthful manner by the trail.

A systematic investigation of the subject would, I think, be very valuable as throwing light upon the processes in the retina.

Both Prof. Young ("whatever the true explanation may turn out to be, the phenomenon at least suggests the idea of a *reflection of the nervous impulse* at the nerve extremities, as if the intense impression upon the retina, after being the first time propagated to the brain, were then reflected, returned to the retina, and, travelling again from the retina to the brain, renewed the sensation") and Mr. Bidwell ("the series of phenomena seem to be due to an affection of the optic nerve which is of an oscillatory character," &c.) appear to incline to what I may call a *physical* view of the phenomena. The phenomena appear to me to point to some *chemical* action on the retina, and to depend in a great measure on the *rate* at which this action goes on. It would be of great interest to consider the phenomena in connection with Hering's theory of colour sensation; according to it these sensations are due to changes in a certain substance, in such a way that changes of a destructive or dissimilative character give rise to the sensations of white, red, and yellow, whilst those of a constructive or assimilative kind produce the sensations of black, green, and blue ("Zur Lehre vom Lichtsinne," Wien, 1878). It may be that this work has been already done; if so I must crave the indulgence of those who have made the subject a special study.

H. FRANK NEWALL

Crowthorne, Wokingham, May 18

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### "Speed" and "Velocity"

SOME of your "general" readers, like myself, may wish to see the distinction between "velocity" and "speed" more easily defined than by a reference to the calculus of quaternions, to which I believe the term "tensor" appertains.

"Speed" is not in the index to the new edition of Part II. of Thomson and Tait. Maxwell, at p. 26 of "Matter and Motion" says, "The rate or speed of the motion is called the velocity of the particle." Tate, in his "Properties of Matter," p. 5 writes about "water of motion; *i.e. Speeds.*" It seems thus:—

(1) Rate of motion is velocity (Maxwell)
(2) Speed of motion is velocity ,,
(3) Rate of motion is speed (Tate).

From (1) and (3) it appears as if velocity and speed must be the same, as indeed (2) seems to assert. But we are told this is not the case. Cannot the distinction between the two be made more generally intelligible than by saying that "speed" is the "tensor" of velocity.

SENEX

[When Maxwell introduced to junior students the *Diagram of Velocities*, he made velocity include the *direction* of motion as well as the mere *rate* of motion (*i.e.* speed).—ED.]

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### The Male Sole is not Unknown

IN last week's issue of NATURE is what is said to be an abstract of a paper read at the Society of Arts by Prof. Ray Lankester, in aid of a proposed marine laboratory, and, passing over what he stated generally requires elucidation, he gives one example of *what is not known among fishes*, and which in the first instance will be investigated at Plymouth. He is made to say "at present absolutely nothing is known as to the spawning, of the sole—the male fish is not even recognised."

In times gone by the plaice was asserted to have ascended from a shrimp, but this, I think, is the first time that the existence of the male sole has been declined recognition. Omitting references to others, I will merely draw attention to the fact that in my collection of British fishes in spirit at the "Great International Fisheries Exhibition," and which is now deposited in the Economic Museum at South Kensington, is a fine example of the male sole, with the milt quite ripe.

I must apologise for pointing out the foregoing, but were such an error left unnoticed in a scientific paper, some practical fisherman will possibly direct attention to it, as the comparative rarity of the male to the female sole has been frequently observed upon in our weekly sporting journals during the last few years.

Cheltenham, May 23 FRANCIS DAY

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### The Aurora of March 15, 1885

NATURE for March 26 (p. 479) contains an account of a fine aurora observed at Christiania, Sweden, on March 15, by Prof. Sophus Tromholt. I would call attention to the fact that an aurora (a very unusual phenomenon at this place) was visible here on the evening of March 15. It was first seen at about 7 p.m.

At the above time several streamers were noticed ascending somewhat east of north: after a short interval these died leaving a white nebulous cloud of light at an altitude of about 10° near a point some 10° or 15° east of north. Shortly afterwards streamers appeared ascending some 10° or 15° west of north: these presently disappeared, leaving a mass of light similar to that left in the east of north. Several times feebler streamers made their appearance west of north. The rays did not attain a greater height than some 20°, and by 8½h. all was quiet, save an auroral glow along the horizon some few degrees east of north, which remained throughout the night. I have thought this might be interesting in connection with the Christiania aurora.

Longitude west of Washington = 0h. 39m. 0·68s.
Latitude ... ... ... ... = +36h. 8m. 58 25s.

E. E. BARNARD

Vanderbilt University Observatory, Nashville, Tenn., U.S.A.

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### Catalogue of Fossil Mammalia in the British Museum, Part I.

IN reply to Mr. Lydekker's comments on the review of his work (NATURE, vol. xxxi. p. 597) I am glad to find that the author repudiates the Owenian system and its errors, though his recognition of the three upper premolars in *Vespertilio* as corresponding, respectively, to *pms.* 2, 3, and 4 of the typical series of four, and the minute anterior upper premolar of *Rhinolophus* as *p.* 3, added to the strange absence of any note on the presence of exceptions to the supposed rule that the premolars decrease in number by reduction from the anterior extremity of the series would certainly lead any one acquainted with the subject to believe that he had acted on it. The only clues afforded by the work which indicate that the Owenian system was not adopted in its entirety, now pointed out by Mr. Lydekker as existing at pp. 152, 174, would certainly escape the notice of any one who had not actually spelled through the work, as I feel sure whoever will take the trouble to refer to will agree with me.

There is no evidence whatever to support Mr. Lydekker's assumption that the two anterior premolars in *Vespertilio* and the anterior premolar in *Rhinolophus* correspond, respectively, to *pms.* 2 and 3 and to *p.* 3 of the typical series. On the contrary, the small size of the second premolar in *Vespertilio* points to reduction by loss from the middle of the series, as we find in the greater number of species of the closely-allied order, Insectivora, and, as we know, takes place in the mandible of several species of Chiroptera.

With reference to the wish expressed in the review that, instead of writing a mere catalogue of the fossil mammals in the British Museum, Mr. Lydekker had undertaken one of all the known species, and his objection, while regretting that the intended friendly estimate of his capability for such a work has been so hostilely received, I maintain that such should have been undertaken; but Mr. Lydekker's remarks show how necessary it is, and that the objection that new genera and species are being made almost daily (it is probable that they will continue to be be made to the end of time) might be applied with equal force on behalf of the birds by Mr. Sharpe, who nevertheless continues his excellent catalogue. It is only by the publication of such a work that we can hope to limit the manufacture of "empty names," such as Mr. Lydekker objects to, and to reduce to order the vast amount of scattered information and contesting opinions which encumber the study of the subject.

THE REVIEWER

## THE ORCHID EXHIBITION

THE Exhibition held in the Conservatory at South Kensington on the 12th and 13th inst. in connection with the Orchid Conference of the Royal Horticultural Society, must have furnished to the least observant visitor some explanation of the fascination exercised by orchids over their cultivators. The beauty, the variety, the strangeness of the flowers of the Orchideæ attract and interest the least enthusiastic even of the lovers of nature. But the variation in flower, compatible with botanical inclusion in one family, is not more marked than is the difference in mode of flowering and of growth. Could there be in one natural order a stronger contrast than between the mode of growth and the gorgeous flowers of the genus Cattleya—essentially "flaunting flowers"—and those of the genus Masdevallia, where the conspicuous part of the flower consists of the three sepals, drawn out in many species into thread-like tails many inches long, and ranging in colour through every shade of orange, scarlet, and purple, down to an almost inky black!

While a larger array of specimen plants has often been seen than was shown at the Conference, there has never been gathered together in any country so varied and interesting a collection, nor one containing so many rare and curious plants. Great as was the interest for the cultivator, it was no less great for the botanist. Mr. Ridley, of the Natural History Museum, who, in conjunction with Mr. Burbidge, of the Dublin Botanic Gardens, has undertaken to draw up a report on the Conference Exhibition, found that sixty-one genera of orchids were represented. For the first time in the history of flower-shows there was a numerous collection of hybrid orchids, raised by artificial fertilisation, in flower. For the first time was there a large collection of orchids in fruit. The progress of hybridisation, greatly due to the energy and skill of Messrs. Veitch and Sons and their intelligent foremen, Mr. Dominy and Mr. Seden, has already been fertile in valuable results for the cultivator. An excellent little book lately published,[1] gives a list of eighty-nine hybrids already in cultivation, distributed among twelve genera, but thirty-seven of them belonging to the genus Cypripedium. Those who are privileged to enter the penetralia at Chelsea know that there are there and elsewhere great numbers and varieties of hybrids, which are slowly surmounting the dangers and delicacy of infancy and childhood.

But the labours of the hybridiser promise to be of great value to the botanist. Mr. Harry Veitch, in his very suggestive and interesting paper on the "Hybridisation of Orchids," read at the Conference, says: "How will these bigeneric crosses affect the stability of the genera as at present circumscribed?" It is well established already that the genera Lœlia and Cattleya cross freely with one another, and Mr. Veitch refers in his paper to two other bigeneric hybrids, which have already flowered, and to others which have been raised, but have not yet flowered.

Unfortunately it must be a long time before orchid cultivators generally can enjoy the results of hybridisation. Mr. Veitch gives the time the hybridist must wait to see the result of his labours, as follows:—

| Genus. | Time from Germination to Flowering |
|---|---|
| Dendrobium | 3 to 4 years. |
| Phaius | About the same. |
| Calanthe | |
| Masdevallia | 4 to 5 years. |
| Chysis | |
| Zygopetalum | 5 to 9 years. |
| Lycaste | 7 to 8 years. |
| Lœlia | 10 to 12 years. |
| Cattleya | |

With the exception of the genera Dendrobium and Cypripedium, it is a long time before sufficient plants of a hybrid can be obtained for distribution, even under the most skilful cultivation. For this reason many of the more beautiful hybrids will probably remain scarce and valuable for years. The high prices paid by collectors for orchids in some cases have been a source of merriment to the uninitiated. Speaking generally, orchids were never so cheap or so plentiful. But if a collector must have a hybrid which has been raised by skilful hands and nursed into vigour by years of patient care—or, on the other hand, must have a beautiful natural variety which has been picked out of millions of plants—if he must have them, he must pay for them.

The Royal Horticultural Society is to be congratulated both on the botanical and the horticultural results of the late Conference. The Conference was a new idea, a new departure. It has demonstrated the great, widespread, and, better still, the intelligent interest taken in a singular and beautiful natural order, and the skill brought to bear on its cultivation.

The short scientific contributions of Prof. Reichenbach, whose absence was universally regretted; the paper on "Hybridisation," by Mr. Veitch, and the brief discussion which ensued, were listened to by a large and appreciative conference. The paper on "Cultivation," by Mr. O'Brien, was also interesting and valuable. The very difficult question of nomenclature, which is in so confused and unsatisfactory a state as to ill brook delay, was postponed. It could not be discussed with advantage at the tail of a long meeting, and will be referred, it is to be hoped, to a scientific committee selected from botanists in and out of the Royal Horticultural Society.

T. L.

## WHEAT-PRODUCTION IN INDIA[1]

INDIA has recently exhibited her extraordinary powers as a wheat-producing area of vast extent. Up to the year 1877 the British wheat-grower looked upon exhaustless prairies of the far West as his most f

[1] "Orchids: a Review of their Structure and History." Illustrated. By Lewis Castle. (*Journal of Horticulture* Office, 171, Fleet Street, E.C.)

[1] The Wheat-Production and Trade of India. Calcutta. collection of correspondence in continuation of papers published

able rival in the matter of wheat-growing. A short seven years has greatly altered his feelings in this respect, and we are probably right in considering that the far East is destined to do its part in forcing down the price of wheat to as great a degree as the land of the setting sun. The *brochure* before us is a thoroughly dry statement of facts composed of numbered despatches, letters, and tables, all bearing upon the capabilities of India as a wheat-producing country. The reader will not, however, obtain information as to extent or area, except in a more or less incidental manner. The principal matters dealt with are (1) the quality and comparative values of the various wheats grown; (2) the modes of cultivation pursued; (3) the nature of the soils on which wheat is grown; (4) the average yield per acre; (5) the effects of continuous wheat-growing in diminishing yield; and also other matters relating to the details of wheat-cultivation in India.

With regard to the quality of Indian wheats there is no room for doubt. The conclusions arrived at are based upon actual weight per bushel, value upon the Corn Exchange at Mark Lane, and an elaborate report upon milling and bread-making results furnished by Messrs. McDougall Brothers of 10, Mark Lane, London. From whichever of the above points of view we test the quality of the Indian wheat, the result is equally satisfactory, and the more so when we find that from year to year the samples and bulk continue to improve. Messrs. McDougall Brothers go so far as to sum up their experience by saying, "glancing at all the facts, it is evident that these wheats afford a larger margin of profit both to the miller and baker than any other."

The modes of cultivation adopted are of great interest. They usually exhibit vast pains, and are in this respect superior to the system of wheat-cultivation employed at home. Such elaborate cultivation would indeed astonish an English farmer accustomed to plough his lea land or turnip land once for wheat. The comparison is less fair if we take into consideration the fact that one thorough English ploughing may be worth half-a-dozen of those "ticklings" of the soil which, under Indian skies, are sufficient to make it "laugh." Under the head of Systems of Cultivation we read:—"Ploughed in July, and again six or seven times until October. Watered in November. Again ploughed twice, rolled, ploughed again, and the seed sown through a tube attached to a plough-handle. After twenty-five or thirty days, again watered; and this is repeated until the plants appear fortnightly where irrigation is by lift, and every twenty-five days where it is by flow. In February, when the ears have appeared, water is given weekly until the ears begin to mature." In Armritsar;—"Six months before sowing, the land is ploughed five to ten times. After sowing, the crops are watered not less than six or more than nine or or ten times." In Gujrat:—"Land is broken up and ploughed many times between May and September, manured and ploughed and levelled." The average produce per acre after this system of cultivation varies from seven to fourteen or even twenty maunds (nine to twenty-seven bushels of 61 lbs.), and yet it is calculated that it is grown at from 8*s.* to 11*s.* per quarter! Wheat-growing appears to be carried on upon all sorts of soils. Upon stiff loams, sandy loams, hard clay, and "every kind of soil." In reply to the question, Has the productive power of the soil begun to fail? the answers are usually in the negative, or that it is not apparent. Still, as might be expected, better crops are grown upon manured and irrigated soils and upon those newly broken up from pasturage.

After reading the details of wheat-cultivation in India and compared its results with those obtained in England with a fifth part of the labour, we are inclined to wonder greatly that this remote field should be able to compete with us. Why do they plough five to ten times? How is it that in that sunny land, and after all this expense [illegible] of labour and irrigation, twenty-seven bushels should [illegible] a maximum return, while in some cases seven bushels [illegible] all that is reaped? A painstaking farmer in England hopes for from thirty-two to forty bushels per acre [illegible] once ploughing and pressing his clover leys, and [illegible] cannot make both ends meet, nor yet compete with [illegible] Indian Ryot.

JOHN WRIGHT [illegible]

## *THE REPORTS OF THE UNITED STATES COMMISSION OF FISH AND FISHERIES FOR* 1881 *AND* 1882[1]

THE Report for 1881 was presented to the Senate [illegible] Congress of the United States on March 17, [illegible] is to be regretted that so long an interval was allowed [illegible] elapse before its publication. The volume is a large [illegible] three inches in thickness, and containing nearly [illegible] pages. Scarcely any of this large quantity of letterpress is without interest and value, and we here give [illegible] account of the work described in it.

The Commission began the second decade of its [illegible]ence in 1881, and the present report shows how [illegible] the organisation has extended itself, and what [illegible] results it has achieved in its first ten years. The [illegible] offices of the Commission are at Washington, and [illegible] the year 1881 were confined to the private res[illegible] its public-spirited chief, Mr. Spencer Baird, who [illegible] the greater part of his house to the State service [illegible] remuneration. In 1881 a building was erected [illegible] the Commissioner's residence, at the public expense, [illegible] provide space for the increased administrative work. The stations where the varied operations of the Commission are carried on are scattered throughout the United States territory. These operations fall naturally under three heads: (1) Economical statistics and historical data concerning the fishing industries; (2) the applied science [illegible] regulating fish supply and distribution; (3) the pure science of marine zoology. The part of the work belonging to the first of these divisions is conducted partly [illegible] the central offices, partly at the seats of the industries [illegible] question. The two other fields of work are, of course, not always distinctly separate. Since 1878 buildings [illegible] Fort Wharf, Gloucester, Mass., had been occupied [illegible] hatching operations, but in 1881 they passed into the possession of a private firm, since which time [illegible] ports on the fisheries and records of ocean and [illegible]spheric temperatures have been obtained from Gloucester. The principal site of the purely scientific work during the summer season was Wood's Holl, Mass., where the Commission possessed a sea-side laboratory. Researches [illegible] the artificial propagation of oysters, &c., were carried [illegible] at St. Jerome, Md., near the mouth of the Potomac. Cultivation of the land-locked or Schoodic salmon [illegible] practised on the Grand Lake Stream, near Calais, [illegible] The Penobscot or Atlantic salmon (*Salmo salar*) [illegible]larly received attention at Buckport, Me. Another station, where lake trout, brook trout, California [illegible] &c., were hatched, was at Northville. The [illegible] hatchery for the Californian salmon was on the McCloud River, a branch of the Sacramento. Shad eggs were hatched at Battery Island, Md., at North-East River, Md., near the mouth of the Susquehanna, at the Central Station, Armory Buildings, Washington, at Washington Navy Yard, on the Potomac river-barges, and at Avoca, N.C. Carp ponds were maintained at Monument Lot and the Arsenal, Washington. The Commission acknowledges valuable assistance received from almost all departments of the Government, but especially from the Navy Office, which, in compliance with decrees of Congress, has detailed steamers fully manned and equipped, lent launches, and executed work and repairs at the navy yards. Some [illegible]

[1] Washington, 1884.

and telegraph companies have also aided in the of the Commission.

till 1879 the Commission was not in possession of vessel of considerable size: its explorations at sea carried on by means of boats either hired or lent by avy. In 1879 Congress voted money for the building steamer to be entirely devoted to the work of the nisation. This vessel was designed as a floating hing station capable of being moved from place to e according to the season and the opportunities ·ded, but she was not intended to go to sea in all thers or to any great distance. She was named the i-*Hawk*, and was built at Wilmington, Del., from the gns of Chas. W. Copeland, consulting engineer of the hthouse Board. A very complete and interesting ort is presented in the volume before us on the con- iction of the *Fish-Hawk* and the work performed by in 1880; and another on her services in 1881. The *h-Hawk* is 156 feet long over all, 27 feet in the beam, 17 feet 2 inches in draught at the stern. Her ordinary ed is about 9 knots an hour. The hull below the in deck is of iron, sheathed with yellow pine; above main deck she is of wood. The hatching apparatus d machinery for working it are placed on the main deck mediately abaft the forecastle; the space thus set apart 47 feet in length. On the after part of the main deck the principal cabin, which contains the Commissioner's ice. Above the main deck, extending from stem to rn, is a promenade deck, on which are the hoisting and ling engine, the dredging boom, its heel attached to foremast, and at the after end the naturalists' labora- y. The vessel is rigged as a fore and aft schooner, rrying a fore-staysail, a foresail and mainsail; she s four boats, the largest of which is a steam-cutter.

The *Fish-Hawk* has been found to fulfil admirably the rpose for which she was designed, viz. the economical d effective hatching of shad. But it had long been ident that the Commission required also a sea-going amer to investigate the conditions and extent of the own, and to discover new, fishing-grounds, to ascertain e complete history of the migrations of food-fishes, to ld, if possible, to the list of species available as food, and study marine phenomena in general. The reward to expected from this kind of work was indicated by the story of the discovery of the tile-fish, an entirely new ecies of which some specimens were brought in by a shing-vessel in 1879. The *Fish-Hawk* made a trip to e place where the tile-fish was found, at the western lge of the Gulf Stream, and found that it was as bundant over a large extent of ground, as the cod is in ther places. The area dredged over was found to be lso in other respects a valuable fishing-ground, and ex- remely rich in all forms of life, many new and interesting pecies being discovered. The tile-fish has been found be of great value as food when fresh, and to be as asily salted and preserved as the cod. In consideration f these facts Congress voted 103,000 dollars for the uilding of an ocean steamer for the work of the Com- mission, to be called the *Albatross*.

In 1881 the Commission began the publication of another annual volume in addition to its Report. It is called the Fish Commission Bulletin, and the first issue contained a memoir on the development of food-fishes, by John A. Ryder; one on the life-history of the eel, by G. Brown Goode; one on the salmon disease in English waters, by Prof. Huxley and S. Walpole; and other papers on fish- hatching and fisheries. Besides this were published in 1881 four census bulletins, and a volume of tables con- taining statistics of American fisheries, all prepared under the supervision of members of the Commission. In the latter part of the year a monograph on the oyster industry was issued by Mr. Ernest Ingersoll.

The results of the year's work in the three several de- partments already defined are given in three separate appendices to the Commissioner's report. Those belong- ing to the first department are contained in Appendix B, which consists of six memoirs, only two of which refer to American fisheries. The first of these is on the history of the mackerel fishery, by Messrs. Brown Goode, Collins, Earll, and Clarke, and occupies nearly a third of the whole volume. It begins with an account of the natural history of the fish, and of its geographical distribution, by Mr. Brown Goode. He finds that the species (*Scomber scombrus*) is confined to the North Atlantic. Its southern limit on the American coast is Cape Hatteras, lat. 35°; its northern limit, the Straits of Belle Isle, lat. 52°, though stragglers may occur further north. Its northern limit on the European coast is North Cape, lat. 71°; its southern, the Mediterranean. The mackerel appears in large shoals on the American coast every summer; as yet it has not been ascertained where it passes the winter. Prof. Hind, who is a Canadian, believes that the fish hibernates in the mud, near shore. Mr. Brown Goode, with much greater probability, argues that the shoals move out to the deep ocean in autumn. He distinguishes between the littoral and bathic migrations of this and other species, and con- cludes that this fish, like others of similar habits, is in- fluenced in its movements chiefly by temperature, food, and breeding instincts. The mackerel only remains near shore while the temperature of the water is above 40° F. Off Cape Hatteras mackerel first appear about March 20; in the Gulf of St. Lawrence they are not abundant till June. The shoals disappear in October, though occasion- ally some are caught in December. The mackerel spawn in water of 15 fathoms and less, and while spawning do not take bait, or rise to the surface. The eggs are pelagic, and the young fish grow to 6½ or 7 inches in the first season, probably reaching full size in four years. The mackerel's food consists chiefly of pelagic forms, but not so exclusively as in the case of the herring. A great deal of space is given in this account to the evidence of fishermen as to the food of the mackerel, but as no scientific interpretation is given of their somewhat vague descriptions, the reader does not learn much from the discussion. We conclude that the food consists largely of copepoda, crustacean larvæ, schizopoda, and ptero- poda. One paragraph dealing with the food question is, to an English reader, somewhat amusing. The author says that the food of the mackerel is called in England the "mackerel-mint," and consists of "sand-lants [*sic*] and five other species of fish." We are not sure, but we think "mackerel-mint" is a mistake for "mackerel-midge," which is the young of various species of rockling, but especially of *Motella tricirrata*. In the same paragraph it is said that mackerel have been seen to devour the swimming larvæ of tape-worms. The first chapter of the essay can only be regarded as a preliminary inquiry to serve as a basis for accurate investigation. It seems strange that Prof. Brown Goode and Mr. Baird should mention a mysterious membrane over the eye of the mackerel without giving the anatomical meaning of the membrane; and it is equally unsatisfactory to read an account of the dissection of a mackerel, quoted from Bernard Gilpin, in which the air-bladder and the aorta are mixed up. Next follows a history of the mackerel- fishery in the United States, from which we learn that since 1880 the purse-seine has come into general use for mackerel-catching. The mackerel fleet consists of 468 vessels, mostly of 60 to 80 tons, schooner rigged, and very fast sailers. The old method of hook-fishing is described fully in a historical chapter. Besides the purse-seine, gill-nets are also used in mackerel fishing at the end of the season, off the New England coast. The total catch of mackerel in 1881 off the United States coast is estimated at 294,667,000 fish.

Chapter III. of the essay contains an account legislation affecting the mackerel fishery. Ever time of printing the Report in 1881, on accoun

Prof. Ryder's remarks at the end of this paper ... "Retardation" somewhat ... experienced in reading the account of his ... In the present state of science it is ... of the nucleus as a "directive dynamic ... the phrase has little definite meaning ... that the division of a nucleus has been d... Flemming under the terms "systole" and "dia... those words referred to ... movements in a nucleus previous to its d... of the nucleus does not give us a ... of the phenomena of retardation ... that retardation of development means dim... the rapidity of the rate at which cell-division ... to talk of the vis essentialis of segment... residing in the nucleus is about as instructive ... attempt to localise the horologity of a clock, the ... of a steam-engine, or the sinuponability of a ...

The Report for the year 1882 was published at th... of last year, only a few months after the issue ... volume for 1881. In some respects this, the most ... Report, is the most interesting of the whole ...

year 1882 having been unusually eventful for the mission. During that year the new steamer [Alba]tross was constructed, [illegible] ding a permanent station [illegible] ding at Washington was fitted up as the central station of the Commission, and the surprising fact came out that the tile-fish, [illegible] the Commission had been [illegible] unknown natural causes. Besides the history of these events the Report contains a long and elaborate memoir, by John A. Ryder, on "The Development of the [Co]d," which forms one of the most [illegible] the volume, and some interesting papers on the artificial propagation of the oyster. The rest of the volume is chiefly made up by the usual separate Reports of the various hatching-stations, and papers on American fishing industries.

The appropriation made by Congress for the *Albatross* [in] 1881 was too small, and it was [illegible] that an additional grant was obtained, and the contract for her construction was signed. On November [illegible] the vessel was put into commission with Lieut. Z. L. Tanner, formerly commander of the *Fish Hawk*, as captain. On December 30 the *Albatross* left Wilmington, where she was built, for Washington, on a trial trip. Her total displacement is 1000 tons. A description of the vessel and of her equipment is promised in a subsequent Report. The arrangements for establishing the principal permanent seaside station of the Commission at Wood's Holl made some progress during the year, but were not completed. An agreement was made upon the conditions of the purchase of the requisite land, and all the necessary technical formalities arranged; but it was essential that there should be constructed within the great harbour of Wood's Holl an inner harbour, which would serve for a harbour of refuge as well as for the purposes of the Commission. An appropriation of 52,000*l.* for the new harbour was granted by Congress, but the President decided to defer action upon this and other new items in the harbour bill, and, consequently, the establishing of the Station was delayed for a time. Nevertheless, Wood's Holl was made the head-quarters of the general summer work of the Commission, and a large party were engaged there during July and August working at marine zoology and exploration. The *Fish Hawk* was stationed there during this time.

The central station at Washington was fitted up with shad-hatching apparatus, and was used as the centre from which all young shad hatched on the rivers Potomac and Susquehanna were distributed; the extreme limit of distribution was the Colorado river in Texas. The number of shad fry distributed was over 20,000,000.

The curious history of the tile fish (*Lopholatilus chamæleonticeps*), into the distribution of which researches were made in 1881, is related in a report by Capt. Collins in Appendix B. At the beginning of Capt. Collins's paper an account of the fish itself is given, from which we learn that it belongs to the family Latilidæ, Gill, the representatives of which are mostly inhabitants of tropical seas and of shallow water. The ground where the tile-fish had been found lies between the latitudes of Hatteras and Nantucket, in long. 70° to 71°, about 100 miles off shore, at a depth of 90 to 125 fathoms. In March and April, 1882, vessels arriving at the principal Atlantic sea-ports reported the extraordinary occurrence of vast numbers of large dead and dying fish floating on the surface of the sea over the region where the tile-fish had been found. It was ascertained that a large proportion of these dead fish were tile-fish. In order to determine the extent of the destruction, a steamer was chartered by the Fish Commission, and sent out to the tile-fish ground in September. Not a single Lopholatilus could be obtained, but a new fish belonging to the genus Setarches was discovered, which promised to be of importance as a food-fish. An account of this [illegible] was published in the Fish Commission [illegible]

Prof. Ryder's memoir on the development of the cod [illegible] New York, in February [illegible] were set free [illegible] [illegible] The memoir is a long one, extending to more than 100 pages, and is illustrated by twelve plates of woodcuts. [illegible] the general [illegible] For example, it is stated that in *Gambusia*, at an early stage, the [illegible] and segmental [illegible] are not [illegible] It cannot be said that the [illegible] embryology, such as the [illegible] of the gastrula, or the development of the germ-layers, are much [illegible] by Prof. Ryder's memoir; on the latter point no information is given.

Two other interesting papers are included in the Appendix for Natural History and Biological Research, one by Sidney I. Smith on the Decapod Crustacea from the dredgings of the *Albatross* in 1883, and the other by Prof. Verrill on the fauna of the [illegible] at the western edge of the Gulf Stream. The former of these is an extremely elaborate memoir, accompanied by ten plates of clear and well-executed woodcuts, illustrating species and structures which had not before been sufficiently figured. The paper contains a great number of new species and several new genera; each new species is described with wonderful minuteness, and a long table of measurements being added to each description, no one having occasion to use this memoir will be able to complain of inexactness or incompleteness in the determination of specific distinctions.

The paper of Prof. Verrill is short, being simply intended to indicate the most interesting features of the peculiar area investigated. It was found in the summer of 1882 that the invertebrate fauna, which had been so unusually abundant in 1881, had, like the tile-fish, suffered great destruction in the interval between the two seasons. This was especially the case among the Crustacea, some species, which had been taken in thousands at a single haul, having become extremely scarce. Prof. Verrill believes the remarkable destruction of life had been caused by a very severe storm which occurred in the winter of 1882, and which probably forced out the cold coast water over the Gulf Stream slope.

The whole of Appendix D has reference to oyster culture. It contains six memoirs, two of which describe experiments on the artificial propagation of the American oyster, *Ostrea virginica*. Lieut. Francis Winslow studied the subject at Beaufort, N.C., and at New Haven, Conn.; Prof. Ryder at St. James's Creek, Md. In both cases, though a fair amount of success was obtained in impregnating the ova and keeping the embryos alive to the free-swimming stage, no satisfactory method was discovered of obtaining a supply of attached spat with any certainty. Prof. Ryder and Col. MacDonald on one or two occasions found that their embryos had fixed themselves to the [illegible] of their aquaria in large numbers, but they could not keep them alive more than a day or two after the attachment had taken place.

The growing extent of the piscicultural operations of the Commission, as indicated by the Reports in Appendix E, is marvellous. Statistics of the distribution of shad-fry during 1882 are given in a paper by Chas. W. Smiley; the total number distributed was over 30 millions. The total number of carp distributed was 259,000, of Penebscot salmon 1,716,000, of Schoodic salmon 1,482,000.

It would be extremely interesting to have some information as to the result of all this work, as to the effect produced on the supply of fish in the rivers, and on the productiveness of the fisheries. The Commissioner points out that it is of little use to put anadromous fish into rivers if the waters are obstructed by dams or made uninhabitable by pollution, and a new fish-way to remedy the former difficulty is described by Col. M. MacDonald in Appendix A. But all who are acquainted with the labours of the American Commission would be grateful if Mr. Chas. Smiley would apply his great power of handling statistics to exhibiting the economical results of the piscicultural work.

J. T. CUNNINGHAM

## NOTES

THE statue of Darwin will be unveiled in the great hall of the Natural History Museum, Cromwell Road, on Tuesday, June 9, at 12 o'clock, when Prof. Huxley, President of the Royal Society, on behalf of the memorial committee, will formally transfer it to the care of the [illegible] of the Museum, who will be represented by His Royal Highness the Prince of Wales. Places will be reserved for the committee and subscribers to the memorial, but the greater part of the hall will be open to the public during the ceremony. The statue, which has been executed by Mr. Boehm, R.A., is of marble, and seated, rather larger than life-size; it is pronounced by those who have seen it to be an admirable likeness as well as a fine work of art.

It is now twenty-one years since the *Geological Magazine* was first issued. During all that time Dr. H. Woodward, F.R.S., has been its editor, and for almost the whole of it the principal editor, on whom has rested the burden and chief responsibility of the work [illegible]. It has been a work which has not only cost him much time and labour, but also has been practically unremunerative. His friends among geologists accordingly purpose to [illegible] the [illegible] of the *Magazine* by presenting to him a [illegible] in appreciation of his services to science. A meeting was held last week, at which an influential committee was formed, a list of which will shortly be circulated. The [illegible] secretary is Dr. Hinde, F.G.S.

We greatly regret to record the death of the Rev. Thomas W. Webb, vicar of Hardwick, near Hay, Brecon, well-known for his writings on astronomical subjects. We hope next week to refer to the work he has done in astronomy.

THE death is announced of Mr. Peter William Barlow, F.R.S., the well-known engineer.

A CONGRESS on hydrology and climatology will, it is stated, be held at Biarritz during October next. The French Government has brought the matter to the notice of foreign Governments, in order that the latter may take the necessary steps to be represented at the congress.

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of their aquaria in large numbers, but they could not keep them alive more than a day or two after the attachment had taken place.

The growing extent of the piscicultural operations of the Commission, as indicated by the Reports in Appendix E, is marvellous. Statistics of the distribution of shad-fry during 1882 are given in a paper by Chas. W. Smiley; the total number distributed was over 30 millions. The total number of carp distributed was 259,000, of Penebscot salmon 1,716,000, of Schoodic salmon 1,482,000.

It would be extremely interesting to have some information as to the result of all this work, as to the effect produced on the supply of fish in the rivers, and on the productiveness of the fisheries. The Commissioner points out that it is of little use to put anadromous fish into rivers if the waters are obstructed by dams or made uninhabitable by pollution, and a new fish-way to remedy the former difficulty is described by Col. M. MacDonald in Appendix A. But all who are acquainted with the labours of the American Commission would be grateful if Mr. Chas. Smiley would apply his great power of handling statistics to exhibiting the economical results of the piscicultural work.

J. T. CUNNINGHAM

## *NOTES*

THE statue of Darwin will be unveiled in the great hall of the Natural History Museum, Cromwell Road, on Tuesday, June 9, at 12 o'clock, when Prof. Huxley, President of the Royal Society, on behalf of the memorial committee, will formally transfer it to the care of the Masters of the Museum, who will be represented by His Royal Highness the Prince of Wales. Places will be reserved for the committee and subscribers to the memorial, but the greater part of the hall will be open to the public during the ceremony. The statue, which has been executed by Mr. Boehm, R.A., is of marble, and seated, rather larger than life-size; it is pronounced by those who have seen it to be an admirable likeness as well as a fine work of art.

IT is now twenty-one years since the *Geological Magazine* was first issued. During all that time Dr. H. Woodward, F.R.S., has been an editor, and for almost the whole of it the principal editor, on whom the main burden and chief responsibility of the work has fallen. It has been a work which has not only cost him much time and labour but also has been practically unremunerative. His friends among geologists accordingly purpose to celebrate the "majority" of the *Magazine* by presenting to him a testimonial in appreciation of his services to science. A meeting was held last week, at which an influential committee was formed, a list of which will shortly be circulated. The treasurer and secretary is Dr. Hinde, F.G.S.

WE greatly regret to record the death of the Rev. Thomas W. Webb, Vicar of Hardwick, near Hay, Brecon, well-known for his writings on astronomical subjects. We hope next week to refer to the work he has done in astronomy.

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THE Naturalists' Societies in the East of Scotland have advanced an important stage. They have been established, have worked, and now have formed a union, the first report of which we have now before us. The union embraces the societies in the counties of Aberdeen, Fife, Forfar, Kincardine, Kinross, and Perth, and now consists of ten societies. The president, Dr. Buchanan White, of Perth, explained in his inaugural address the functions of the union as distinguished from those of the individual societies. Its main object of course is to carry on more effectually the work for which each of the societies that compose it has been formed, that work being the promotion of the study of natural science, especially of local natural science. Rivalry [illegible] of communication and connection, he argues, is as valuable to societies as to individuals; and while each society was isolated and worked independently in its own district, the sum total of the work done was necessarily imperfect because of want of uniformity in the matter of details; one subject has been thoroughly worked while another has been untouched, certain districts have been investigated, while others have been neglected, and the relation of one district to another have not been considered. Each society has added in a [illegible] in its own district, and has brought forth good stone, but they lie in an unsorted heap. The union undertakes the task of sorting and utilising them. On this broad principle the union started, and the president laid down in the opening address the programme of its work for the immediate future. The first step was to ascertain the present state of knowledge of the zoology, botany, geology, and meteorology of the six counties included in the union. For this purpose a uniform method of treatment was adopted. Each reporter in his own special subject states how far the subject has been investigated, what parts of it especially require investigation, both as regards the district and the subject, what the probable richness of the district is, what important works, if any, have been published on the subject and district, and, finally, what work should be taken in hand at once. These statements make up the bulk of this first report, and there are in all nineteen, covering almost every department of natural history. The union, it thus appears, directs and organises the work of its affiliated societies, and prevents waste of power.

THE additions to the Zoological Society's Gardens during the past week include a White-bellied Beaver Rat (*Hydromys leucogaster*), a White-bellied Sea Eagle (*Haliaetus leucogaster*), two Stump-tailed Lizards (*Trachydosaurus rugosus*), a [illegible] (*Cyclodus gigas*), a Diamond Snake (*Morelia spilotes*) from Australia, presented by Mr. E. P. Ramsay, C.M.Z.S.; an Australian Cassowary (*Casuarius australis*) from Australia, presented by Mr. T. H. Bowyer Bower; four Pucheran's Guinea Fowls (*Numida pucherani*) from East Africa, presented by Commander [illegible], R.N.; a Kestrel (*Tinnunculus alaudarius*), British, presented by Mr. C. A. Marriott; seven Striped Snakes (*Tropidonotus sirtalis*) from North America, presented by Mr. A. H. [illegible]; a [illegible] (*Tyro[illegible]*) from [illegible], presented by Mr. J. W. [illegible]; two Lions (*Felis leo*) from Africa; two Pumas (*Felis concolor*) from South America, deposited; a Collared Fruit Bat (*Cynonycteris collaris*), four Upland Geese (*Bernicla magellanica*), bred in the Gardens.

## OUR ASTRONOMICAL COLUMN

DOUBLE-STAR MEASURES.—Nos. 2662-63 of the *Astronomische Nachrichten* contain the first instalment of a series of measures of double stars made by Herr R. Engelmann during the years 1882-84, preceded by a comparison of the differences between the observer's positions and distances of a number of stars, with those measured by Dembowski and Asaph Hall, and other particulars bearing upon his own results. For several of the more interesting binaries the following epochs are given:—

| | | | | |
|---|---|---|---|---|
| Castor | 1882·88 | ... | 234°·3 | ... |
| ζ Cancri | 1884·28 | ... | 67·0 | ... |
| ω Leonis | 1884·23 | ... | 91·4 | ... |
| ξ Ursæ Majoris | 1883·42 | ... | 240·6 | ... |
| γ Virginis | 1883·07 | ... | 155·6 | ... |
| 42 Comæ Berenices | 1882·93 | ... | [illegible] | ... |
| ξ Boötis | 1884·45 | ... | 266·6 | ... |

MINIMA OF ALGOL.—The following Greenwich mean times of geocentric minima of Algol have been obtained after a small correction to the period given by Prof. Schönfeld in his second catalogue of variable stars, so as to satisfy more closely the observations of the late Prof. Schmidt in 1882 and [illegible]

| | h. m. | | | h. m. | | |
|---|---|---|---|---|---|---|
| July 25 | 13 10 | ... | Sept. 3 | 16 29 | ... | Sept. 2[illegible] |
| 28 | 9 58 | | 6 | 13 17 | ... | Oct. |
| Aug. 14 | 14 49 | | 9 | 10 6 | | 1[illegible] |
| 17 | 11 38 | | 12 | 6 54 | | 2[illegible] |
| 20 | 8 26 | ... | 29 | 14 57 | ... | 2[illegible] |

CENTRAL SOLAR ECLIPSES IN NEW ZEALAND.—[illegible] known to those who are interested in astronomical [illegible] the track of the central line in the total eclipse of the September [illegible] almost entirely over the Southern [illegible] and that the total phase will only be observable on land [illegible] of Cook's Strait, New Zealand. It would appear [illegible] central eclipse has traversed those islands during the [illegible] an examination of the various ephemerides [illegible] the annular eclipse of December 20, 1796, as the last [illegible] there [illegible]. An annular, though nearly total, eclipse [illegible] the north-east coast of the North Island on [illegible] 3, 1877 [illegible], on May 22, 1885, when the sun is [illegible] [illegible] of 5, he will be totally eclipsed on the [illegible] of the North Island, near its north extremity, for about [illegible]

It is true that in an old catalogue of eclipses which [illegible] transferred into several of our popular astronomical [illegible] those of December 12, 1890, and November 28, 1828, [illegible] then [illegible] central in New Zealand, but an examination [illegible] more recent data shows that neither [illegible] reach that country. In the eclipse of 1890 the central [illegible] in at in longitude 141 W., latitude 36½° S., totality [illegible] with the central eclipse taking place in longitude 120½° E., [illegible] 51° [illegible] and the line thus passing south of New Zealand [illegible] eclipse of 1824 [illegible] not far from longitude 163 [illegible] 56 S.

THE DAYLIGHT OCCULTATION OF ALDEBARAN ON [illegible] 1868.—Mr. H. Sadler reminds us that the occultation [illegible] to which reference was lately made in this column [illegible] by Mr. Newall in 1868, when [illegible] was only some eight degrees from the sun's place, was [illegible] Asaph Hall. The observation is to be found [illegible] Washington Astronomical and Meteorological Observations, 1868, p. 347.

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, MAY 31 TO JUNE 6

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is employed.)

*At Greenwich on May 31*

Sun rises, 3h. 51m.; souths, 11h. 57m. 25·7s.; sets, 20h. [illegible] decl. on meridian, 21° 51' N.; Sidereal Time at [illegible] 16h. 42m.

Moon (At Last Quarter June 6, 0h.) rises, 16h. 16m.*; souths, 1h. 43m.; sets, 1[illegible]h. 4[illegible]m.; decl. on meridian, 18° 2[illegible]

| Planet | Rises | | Souths | | Sets | | Decl. on meridian |
|---|---|---|---|---|---|---|---|
| | h. m. | | h. m. | | h. m. | | |
| Mercury | 1 7 | ... | 10 22 | ... | 17 38 | ... | 13 [illegible] |
| Venus | 4 14 | ... | 12 28 | ... | 20 42 | ... | 23 [illegible] |
| Mars | 2 50 | ... | 10 21 | ... | 17 52 | ... | 16 [illegible] |
| Jupiter | 10 13 | ... | 17 25 | ... | 0 37* | ... | 13 [illegible] |
| Saturn | 4 54 | ... | 13 3 | ... | 21 12 | ... | 22 [illegible] |

* Indicates that the rising is that of the preceding and the setting that of the following day.

*Phenomena of Jupiter's Satellites*

| June | h. m. | | June | h. m. | |
|---|---|---|---|---|---|
| 2 | 22 50 | II. tr. ing. | 5 | 22 43 | I. occ. [illegible] |
| 4 | 23 14 | II. ecl. reap. | 6 | 22 22 | I. tr. [illegible] |

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

## [illegible]EMICAL NOTES

[illegible]icated by Prof. Mendeléeff to the last issue [illegible] Russian Chemical Society, being a reply [illegible] Professor makes a very interesting com[illegible] [illegible]n formula of dilatation of liquids and the [illegible] Waterston, supported in Russia by his [illegible]s. He shows by analysis why both for[illegible] [illegible]fficient approximation the expansion of [illegible]f 0° and 104°, the observations beyond [illegible] left aside until we have a more accurate [illegible] of expansion of this substance at higher [illegible]r higher pressures. He demonstrates [illegible]garithmic formula is as inapplicable to [illegible], developing both formulas into series, [illegible] simpler formula ought to be considered [illegible]n to the law of dilatation of liquids [illegible]scovered. Though polemic in its tone [illegible]terly piece of scientific treatment of the [illegible]portant a question.

[illegible]ines laid down by Mr. H. B. Dixon in [illegible] combustion of carbonic oxide in dry air [illegible]. Brereton Baker has recently described [illegible]ults regarding the combustion of ph[illegible] [illegible]ygen. When the elements in question [illegible] which had been kept in contact with [illegible] some weeks, combustion occurred only [illegible] The presence of a small quantity of [illegible] be needed in order to start the com[illegible] [illegible]*Trans.*, 1885, 349).

[illegible]elative masses of the reacting bodies [illegible] late years received a good deal of [illegible] [illegible]ed the well-established data regarding [illegible] and of the presence of excess [illegible] [illegible]hemical reactions (*Ber.*, xviii [illegible]). [illegible] [illegible]t may act both physically and [illegible] [illegible]ether as a diluent it does not [illegible] [illegible] of the chemical operation. [illegible] [illegible]ars always to exert an influence [illegible] [illegible]ames of the variations in the [illegible] [illegible]bly very complicated, [illegible] [illegible]aining vessel may exert an [illegible]

[illegible]rlled by M. J. Thoulet (*Comptes [illegible]* [illegible] of immersing various solid [illegible] [illegible]le, quartz, &c., in aqueous [illegible] [illegible]oride. In each case a portion of the [illegible] [illegible]sitated on the surface of the [illegible] [illegible]s drawn that there is an [illegible] [illegible] and the solid immersed, [illegible] [illegible]portional to the surface of the solid [illegible]

[illegible]ley showed that when [illegible] [illegible] fall on to filter paper, the [illegible] [illegible] remains in the centre, and [illegible] [illegible] Mr. J. U. Lloyd has extended [illegible] [illegible], ii. 51). He has observed [illegible] [illegible]nres in aqueous solution [illegible] [illegible]dipped into the solution, [illegible] [illegible]r. Great differences were [illegible] [illegible]ent salts thus travelled. [illegible] [illegible] in some cases one [illegible] [illegible]ly behind. [illegible] [illegible]as separated by the [illegible] [illegible]through the paper after [illegible] [illegible]sed. Dilute sulphuric [illegible] In the [illegible] [illegible]ne passed onwards. [illegible] [illegible]water, the rate [illegible] [illegible] the quicker is the [illegible]

[illegible]e to realise that the [illegible] [illegible]ed as final expressions [illegible] [illegible]ations of chemical [illegible] [illegible]as been treated as a [illegible] [illegible] to learn the relations [illegible] [illegible]tten that the molecule [illegible] [illegible] recalled to the [illegible] relation between [illegible] [illegible]arches on the relation [illegible] [illegible]bon compounds and their [illegible] [illegible]s of much interest in the [illegible]

[illegible] a paper communicated to the Chemical Society on May 7, [illegible] Hartley brought forward a series of facts which lead to the conclusion that "molecules vibrate as wholes or units, and the fundamental vibrations give rise to secondary vibrations which stand in no close relation to the chemical constituents of the molecule, whether these be atoms or smaller molecules. Hence it appears that a molecule is a distinct and individual particle which cannot be truly represented by our usual chemical formula, since these only symbolise certain chemical reactions and physical properties, and fail to express any relations between physical and chemical properties."

[illegible] 1885, 74) has been pur[illegible] [illegible] sulphur [illegible] results which lead him [illegible] equivalents of [illegible] ordinary struc[illegible] [illegible] These variations appear [illegible] of the sulphur atom in [illegible] of the other atoms [illegible] Changes in [illegible] seem to be ac[illegible] [illegible] equivalents of these [illegible] cannot be regarded as due to [illegible] of the atom of sulphur [illegible] which affects the molecule as a whole.

[illegible] and important [illegible] raised [illegible] Prof. Mendeléeff's ex[illegible] [illegible] M. [illegible] ably [illegible] of a constitution of [illegible] molecules with [illegible] by the author appears as [illegible] as if a real thing, about [illegible]

[illegible]

still under consideration with the Government in the Dutch Indies. It was mentioned, however, that the expedition would probably go to Dutch or to Oman; many offers to accompany it have been made to the Society.

AT a recent meeting of the Paris Geographical Society, M. Romanet du Caillaud described the life and travels of Ordoñez de Cevallos, who was born at Jaen towards the middle of the sixteenth century, and who commenced his journeys all over the world at the age of seventeen. He visited various countries in Europe, and travelled several times to both Americas. He then became a priest, without, however, renouncing his [illegible] passion. He went as missionary to the Philippines, thence to Canton and Japan. From Japan he set sail for China again, but a storm drove him on the coasts of Tonquin. Having received permission to land, he went to the Court in 1590, and visited various parts of the Indo-Chinese peninsula, Malacca and India. He started then for Buenos Ayres, touching at the Cape of Good Hope, and endeavoured to go to the west coast of South America by the Straits of Magellan, but was prevented by an English fleet, which barred the Straits. He returned to Buenos Ayres, and in 1595 undertook a journey, similar to that in which Crevaux lost his life, by Tucuman, the Paraguay, Potosi, &c., preaching by the way to the savage tribes, whom he calls the Quinos, Cimagras, &c. He fought also against the black Indian cannibals, called by the Spaniards the Cimarrons or Caribs. Ultimately he returned to Seville and became a canon. In 1607 the Bishop of Macao gave him a message from the King of Tonquin desiring him to return to that country, but he could not do so. The works of this indefatigable traveller are: (1) "Historia y Viage del Mundo"; (2) "Relaciones verdaderas de los Reynos de la China, Cochinchina, y Champas" (Jaen, 1628); (3) "Tratado de la Santissima Cruz"; (4) "Descriptio Indiæ Occidentalis" in the "Novus Orbis sive descriptio Indiæ Occidentalis" of Antonio de Herrera (Amsterdam, 1622).

A BLUE BOOK just issued by the Foreign Office contains five maps referring to the Russo-Afghan boundaries. The first is a chart of the route followed by members of the Boundary Commission from Kushan to Bala Murghab; the second is a reproduction in English of a Russian military map of the frontier; No. 3 is a copy of a map of South-Western Turcomania, produced in Russia; No. 4, which was prepared by M. Lessar, shows his explorations; while the last is a sketch map to illustrate the various routes and lines of frontier proposed at one time or other recently by Russia and England.

The Austrian Tourist Club has appointed a committee with the view of making experiments for the improvement of the natural drainage of certain parts of the Karst which are liable to periodical inundation. This celebrated region to the north of the Adriatic is remarkable for its underground rivers, which communicate with the surface here and there by vertical shafts. Through these openings the surplus waters escape to the surface when the underground channels are filled to overflowing, and in that way considerable tracts are periodically converted into temporary lakes. The well known Lake Zirknitz is only one of dozens of such lakes that are formed in this district every year. The practicability of preventing these inundations by enlarging the underground channels has been discussed on several occasions in the Tourist Club, and now the first attempt to carry this scheme into effect is about to be made with the Pinka Jama, a natural [illegible] leading down to an underground channel about a mile and a half from the Adelsberg Cavern.

HERR GLASER, the Austrian explorer, is about to undertake a new journey in Southern Arabia. He will go first from Sanaa to Marib, and will then visit in succession Wadi Dauasir, Nedjd, Oman, and Hadramaut. In a similar journey which he made some time ago he brought back 250 inscriptions of the Sabeans, who were regarded in the time of the Ptolemys as the wealthiest people of Arabia.

CAPT. JENNINGS, of the Royal Engineers, has returned to India (according to the *Times*) after a successful exploration of South-eastern Persia, including the hitherto unknown Sarhad country. He specially examined all the roads and the configuration of the country, and is said to bring back a mass of useful information with regard to the region.

THE last number (25) of the *Excursions et Reconnaissances* of Saigon contains, among others, two papers by that indefatigable student of Indo-China, Capt. Aymonier, one on Cambodian epigraphy, the other on a journey in Laos. Dr. [illegible] gives the second part of his paper on the reptiles of China and Cambodia, and M. Harduin concludes the [illegible] of a recent journey in Siam.

*Petermann's Mittheilungen* (No. 5, 1885) contains a [illegible] accompanied by an excellent map, on Kaffraria and the boundary lands of the Cape Colony, by Herr Schunk, observations on the sanitary features of the Upper Amu [illegible] and an account of the Geographical Congress at Hambur[illegible]

## A YEARLY AND A DAILY PERIOD [illegible] TELEGRAPHIC PERTURBATIONS

SINCE July 1, 1881, all disturbing currents at forty-[illegible] graphic stations in Norway and Sweden regarding duration, force, direction, &c., have been at my request re[illegible] recorded. These observations will of course first obtain importance when a longer series is available; still, I be[illegible] would be of interest at present to investigate whether [illegible] telegraphic perturbations similar yearly and daily period[illegible] be established, such as have been proved for the auro[illegible] other terrestrial magnetic phenomena. My time being rather limited, extensive researches are not possible; [illegible] ments and forty-four stations I have therefore selected [illegible] herewith present the results of my investigations.

The four stations are named and located as follows:—

| | | |
|---|---|---|
| Kistrand | 70 25 N. | 25 13 E.G |
| Lødingen | 68 24 „ | 16 1 „ |
| Trondhjem | 63 27 „ | 8 5 „ |
| Bergen | 60 24 „ | 5 20 „ |

My researches have been made for the three years from [illegible] 1881, to June, 1884. As the Norwegian stations do [illegible] night work, the observations could only be taken from 7 [illegible] in the morning till midnight.

I have first noted the number of days for each month on [illegible] telegraphic perturbations have been observed, excluding [illegible] caused by thunder storms. These numbers [illegible] the tot[illegible] each month and year are shown in Tables I. to IV.

TABLE I.—*Kistrand*.

| Month | 1881 to 1882 | 1882 to 1883 | 1883 to 1884 |
|---|---|---|---|
| July | 4 | 2 | 8 |
| August | 0 | 12 | 3 |
| September | 7 | 12 | 11 |
| October | 14 | 20 | 6 |
| November | 10 | 22 | 3 |
| December | 13 | 8 | 3 |
| January | 5 | 7 | 0 |
| February | 7 | 10 | 9 |
| March | 13 | 16 | 4 |
| April | 25 | 6 | 12 |
| May | 19 | 4 | 3 |
| June | 14 | 5 | 5 |
| Year | 128 | 124 | 67 |

TABLE II.—*Trondhjem*.

| Month | 1881 to 1882 | 1882 to 1883 | 1883 to 1884 |
|---|---|---|---|
| July | 7 | 5 | 10 |
| August | 4 | 8 | 3 |
| September | 10 | 6 | 1 |
| October | 15 | 11 | 0 |
| November | 18 | 16 | 6 |
| December | 14 | 6 | 5 |
| January | 12 | 7 | 1 |
| February | 16 | 10 | 4 |
| March | 13 | 8 | 7 |
| April | 14 | 4 | 2 |
| May | 17 | 2 | 1 |
| June | 6 | 6 | 3 |
| Year | 141 | 89 | 51 |

The monthly totals for the three years are graphically re[illegible] sented in Fig. 1. Both the numbers and the figure show ap[illegible] ently that the yearly period for the telegraphic perturbation[illegible] identical with that of the aurora, i.e. its maximum coincides [illegible] both solstices and its minimum with both equinoxes. Of espe[illegible] importance is the minimum at the time of the summer sol[illegible] when the aurora, as is well known, ceases, on account of nights. The perspicuity with which [illegible]eriod is drawn in the four representa- [illegible] be called surprising, considering the [illegible]ly embraces three years.

Fig. 1.

III. [illegible]

| | | |
|---|---|---|
| 4 | 3 | [illegible] |
| 3 | 1 | [illegible] |
| 3 | 3 | [illegible] |
| 11 | 1 | [illegible] |
| 14 | 4 | [illegible] |
| 5 | 6 | [illegible] |
| 4 | 6 | 23 |
| 10 | 3 | [illegible] |
| 0 | 6 | 17 |
| 4 | 3 | 12 |
| 3 | 2 | [illegible] |
| 0 | 0 | [illegible] |
| 75 | 20 | [illegible] |

IV. [illegible]

| | | |
|---|---|---|
| 1 | 3 | [illegible] |
| 3 | 2 | [illegible] |
| 1 | 1 | 12 |
| 3 | 4 | [illegible] |
| 10 | 3 | [illegible] |
| 6 | 1 | [illegible] |
| 1 | 2 | 12 |
| 9 | 0 | [illegible] |
| 4 | 4 | [illegible] |
| 3 | 1 | [illegible] |
| 2 | 0 | 4 |
| 1 | | 121 |
| 44 | 21 | |

[illegible] the great frequency [illegible] [illegible] way compared with [illegible] In the totals of the years [illegible] is visible which [illegible]

with the [illegible] of the aurora during recent years in this [illegible] it will probably be seen how [illegible] have the 11 year period in common [illegible].

In order [illegible] I have investigated how often [illegible] from 7 a.m. till midnight [illegible] including those caused by [illegible]. Table V. shows the result:—

TABLE V.

| | | | | | | |
|---|---|---|---|---|---|---|
| Kistrand | 42 | [illegible] | [illegible] | [illegible] | 111 | 137 |
| [illegible] | [illegible] | [illegible] | 84 | [illegible] | 88 | 88 |
| Lodingen | [illegible] | [illegible] | 39 | 48 | 47 | 41 |
| Bergen | [illegible] | [illegible] | 23 | 24 | 28 | 29 |
| Kistrand | [illegible] | [illegible] | [illegible] | 155 | [illegible] | 192 |
| Trondhjem | 51 | [illegible] | [illegible] | 91 | [illegible] | 123 |
| Lodingen | [illegible] | 41 | 43 | 57 | [illegible] | 80 |
| Bergen | [illegible] | 45 | 57 | [illegible] | 48 | 47 |
| Kistrand | [illegible] | 247 | [illegible] | [illegible] | [illegible] | [illegible] |
| Trondhjem | [illegible] | [illegible] | [illegible] | 77 | [illegible] | 61 |
| Lodingen | [illegible] | [illegible] | [illegible] | 70 | [illegible] | 54 |
| Bergen | [illegible] | [illegible] | [illegible] | 51 | [illegible] | 59 |

Fig. 2 gives [illegible] it will

[illegible] 11 a.m., [illegible]

A NOTE [illegible] OF [illegible]

[illegible]

author, wrote, towards the end of the sixteenth century, a treatise, "About Greenland." In a second edition (about 1600) he added some extracts from the "Kings-mirror,"[1] and among these, one about the Aurora Borealis. But here he has inserted a remark, which [illegible] a high degree has attracted attention and caused astonishment, and which, till now, has been inexplicable to the investigators of the Aurora Borealis. I give further on a translation of the description of the Aurora Borealis in the "Kings-mirror," and after it the version of Peder Claussøn:—

*Kings-mirror.*

"Such a nature and [illegible] has the north light, that the more obscure the night, the more brilliant it appears, and only in the night [illegible] during the daytime, and especially [illegible] but seldom by moonlight. It appears as a [illegible] seen from [illegible]. Out of this flame [illegible] up in the air, sharp points of unequal [illegible] so that now one, then the other [illegible] this light is pendent like a [illegible]. As long [illegible] are most intense and bright, [illegible] from these streams of fire and rays, that [illegible] find their way, and even go a hunting, [illegible]. Also, when people are in houses [illegible] it is so bright inside that all present [illegible]. But this light is so [illegible] that it sometimes [illegible], as if a black smoke or a heavy nebulous cloud [illegible] it, and then shortly again it seems as if the light were [illegible] to be smothered in this smoke, and almost become quite extinct. But as soon as this fog commences [illegible] the light brightens, and clears up for the second time, and it happens even that one would believe that heavy sparks [illegible] as from a red-hot iron just taken out of the forge. When the night declines, and with daybreak the light begins to [illegible], and when the day has set in it seems [illegible] to disappear.

*Peder Claussøn Friis.*

"In Greenland [illegible] and bright light is seen on the sky during the night, which [illegible] in the following manner: the more obscure the night the more brilliant is the light, that is to say, the [illegible] *is in the [illegible], the more [illegible] in the sky, however, always towards the north,* [illegible] IN THE SKY AS TO BE OBSERVED [illegible] THAN GREENLAND, ICELAND, AND THE NORTHERN PART OF NORWAY, *and for that reason it is called North-light.*

"It appears as a flame of a burning fire, and extends over the *sky like a [illegible] and a [illegible], and [illegible] up and down in a [illegible], the one [illegible] the other, and in the [illegible], one [illegible] up and the other down, and where the flame [illegible] up and down, back and forward* it can grow dim and almost leave behind [illegible] a smoke; *but the* [illegible] *where it* [illegible]. And when [illegible] light is most intense, people can [illegible]. At daybreak the north-light [illegible] away."

The "Kings-mirror" was written about 1250, at all events before 1260, and [illegible] later than 1240. The home of the unknown [illegible] author may be looked for, according to [illegible] of H. Geelmuyden (Christiania [illegible] 63° 51' and 64° 58' N. lat. (not far from the town of [illegible]). This description of the aurora is [illegible] in the aurora literature of [illegible] ages; the [illegible] manner in which he describes the phenomenon has [illegible] at a much later period. It is [illegible], however, that the aurora is mentioned in the "Kings-mirror" as a phenomenon chiefly characteristic of Greenland, and not even an intimation is given as to its being visible in Norway. This description indicates, nevertheless, quite plainly that it is based on the author's own observation of the aurora in his native country, and it is there-fore beyond doubt that he was familiar with the phenom[illegible] although he has considered Greenland—the country si[illegible] according to the opinion of past ages, farthest towards th[illegible] —the proper home of the aurora.

In Peder Claussøn's above quoted version of the [illegible] scription in the "Kings-mirror," I have made the remar[illegible] expressions differing from the "Kings-mirror" conspicu[illegible] italics. It will be seen that his relation is rather free; [illegible] these conspicuous expressions, if not all, point to Claussøn's knowledge of the aurora through his own obser[illegible] The more striking is the conspicuous remark that the au[illegible] Greenland does not appear so high in the sky as to be ob[illegible] in other countries than Greenland, Iceland, and the no[illegible] part of Norway.

This remark has been inserted in many other publica[illegible] and all historians of the aurora from Mairan to Fritz [illegible] themselves with the notable circumstance that, a[illegible]ing to this remark, the aurora was not visible during th[illegible] half of the sixteenth century in Southern Norway. But no[illegible] in the whole history of the aurora is it so evident how [illegible] caution must be displayed in drawing comprehensive infe[illegible] from a single remark of an old author.

Peder Claussøn has, in a single copy of his treatise on G[illegible] land in the year 1604 or 1605, with regard to the aurora, [illegible] the following important "note," hitherto unknown t[illegible] investigators of the aurora:—

"This north-light was, as before said, only seen in past [illegible] in northern countries. But in the period of my infancy, [illegible] the year 1550, it was first seen by people who live i[illegible] southern part of Norway, however not higher on the sky [illegible] the Polar Star. But since the year 1570 it ascends to [illegible] height that it appears to us in the south-east and in a sou[illegible] direction, and I suppose that it is seen at present also in [illegible] countries."

Peder Claussøn's relation is thus in downright contradi[illegible] with the interpretation given to his above mentioned remark [illegible] remains now to explain how he could write, in the year [illegible] that the aurora was only visible in the extreme north of [illegible] way. It may be seen that he had the opinion that the au[illegible] in "past times," was only visible in the northern countri[illegible] the silence of the "Kings-mirror" about this phenomeno[illegible] Norway has perhaps brought him to this unknown remark "and never so high in the sky as to be observ[illegible] &c., therefore, in all probability describes the [illegible] which, after his opinion, took place at the time when "Kings-mirror" was written. The additional clause, "and [illegible] that reason it is called north-light," seems at the same tim[illegible] intimate that he, by the previous remark, would explain [illegible] the author of the "Kings-mirror" uses the expression no[illegible] light (naturally, because it is visible only in the extreme north[illegible] countries).

SOPHUS TROMHOLT.

Christiania.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Two [illegible] have been established at [illegible] John's College on the foundation of the Rev. Mr. Hutchinso[illegible] late Senior Fellow. They are of the [illegible] a year for [illegible] years and are tenable with a Foundation Scholarship. A student of the College who shall be [illegible] engaged in the p[illegible] [illegible] one branch or branches of physical or natural science [illegible] in the study of Semitic or Indian languages, and shall be of [illegible] [illegible] time and not more [illegible] terms' standing fr[illegible] the commencement of his residence in the University shall [illegible] qualified to be a candidate, and if there is no candidate belon[illegible]ing to the College of sufficient merit in these subjects, the Coun[illegible] may elect a student engaged in [illegible], whether a member [illegible] the College or not. The Council [illegible] such conditio[illegible] on the students as shall encourage [illegible] after the b[illegible] [illegible] they may require him to present in writing [illegible] account of his studies, [illegible]. The election w[illegible] take place in June each year.

It will be seen that a Hutchinson student may be free to wo[illegible] at biology in Naples, to join an Eclipse Expedition, to stud[illegible] Pali in Ceylon or Hebrew in Cambridge. We hope to hear [illegible] the Hutchinson students in the future.

The Senate has approved of the [illegible] of a new Chemist[illegible]

[1] The Kings-mirror (Konungs Skuggsjá) is, of its kind, an unparalleled Norwegian work, in which [illegible] and [illegible] have [illegible] the height of [illegible] has [illegible] by philosophy and [illegible] State administration and ethics, in the form of conversations between a father and son. It is a book [illegible] interest, because of the whole [illegible] of culture which it [illegible] in elevated tone.

[2] The author himself never visited Greenland.

Mr. Stevenson's design, and tenders are [illegible] possible.

[illegible] F.R.S., is to be Additional Examiner [illegible]matical Tripos in January, 1886. [illegible] J. J. H. Teall are appointed Examiners [illegible] be adjudged next year.

[illegible] take a class in Osteology during the [illegible] will also be an Introductory Practical [illegible]strated by that of the Dog, superin[illegible] and Mr. Rolleston. The Demonstrator [illegible] Histology during the Long Vacation.

## [illegible]TIFIC SERIALS

[illegible]d Physiology, vol. xix., Part 3, April [illegible] [illegible]pment of the blood-corpuscles in th[illegible] [illegible], by K. F. Wenckebach (plate 11). [illegible] rotation of the fore arm, by [illegible] [illegible] ligaments, part iii., by J. B. Sutton [illegible] cervico-dorsal vertebra [illegible] asymmetry [illegible] abnormal articulation in [illegible] in the histology of [illegible] and cerebellum, by [illegible] The external auditory meatus in the [illegible] larynx [illegible] trachea to the verte[illegible] [illegible] child; a rare abnormality of the [illegible] The existence [illegible] [illegible]

[illegible]

[illegible]logical value of the ova of [illegible] and [illegible], by W. Wall (plates 20-22).—On the power of transformation in the Mexican Axolotl, by Marie von Chauvin.—Contribution to a knowledge of the Trematodes, [illegible], nov. sp., and [illegible], nov. sp., [illegible] (plate 23). —The formation of the radula in the Cephalophorous Mollusca, by R. [illegible] (plates 24 and 25).—[illegible] of the fauna of the [illegible] (plate 26).—[illegible] common developmental processes in Vertebrata, by [illegible]

## SOCIETIES AND ACADEMIES

LONDON

**Royal Society**, April 23.—[illegible] with an Account of some Experiments on the Relation between the [illegible]," by Edward B. Poulton, M.A., of [illegible] College, Oxford.

[illegible]

colour of the more stable pigment—xanthophyll—preponderates over the green of the metachlorophyll in the newly-hatched larva. The bands of xanthophyll are distinctly seen in an alcoholic extract of crushed ova taken from the bodies of moths which have been preserved for ten years or longer. In blown and dried larvæ the greens soon fade, while the yellows persist and the pigment can be detected after many years. The true pigments are also unaltered. In larvæ preserved in spirit the derived pigments quickly disappear, and the alcohol is yellow with xanthophyll, while the true pigments are unchanged. These facts are also true of phytophagous hymenopterous larvæ, as well as in the lepidoptera. Thus in *Nematus curtispina* the green colour is due to derived pigment, while the broad white dorsal band is due to fat collected on each side of the dorsal vessel (and it can be seen to move with the pulsations of the latter). In *Cræsus Septentrionalis* fat becomes the vehicle for a yellow colour. The few exposed pupæ of moths are coloured in the same manner as the larvæ (*e.g.* the *Ephyridæ* and *E. angularia*). In the Ephyridæ, dimorphic larvæ—green and brown—produce pupæ which follow the colour of their respective larvæ. Larval markings can often be seen upon the pupa immediately after pupation. Thus the pupa of *Sphinx ligustri* is marked by the oblique stripes of the larva. The pupæ of butterflies are nearly always protectively coloured, and often possess the derived pigments. In *Papilio machaon* the derived pigments of the pupa are segregated in a very remarkable chitinised (?) subcuticular layer, which is quite opaque, so that no effect is produced by the bright yellow blood (xanthophyll).

*Methods of Investigation and Spectra of derived Pigments.*—Zeiss's micro-spectroscope was always employed, with bright sunlight as the means of illumination. The blood is obtained by pricking the pupa or the larva in some situation remote from the digestive tract. Existing under pressure, most of the blood at once emerges as a clear bright green or yellow liquid (when the derived pigments are present). It is received into a tube-section, with one end cemented to a glass slide, and when full a cover glass is placed upon the open end, becoming fixed by the drying of the blood. In most cases the blood so prepared will keep for months. The spectrum of metachlorophyll is as follows (in the case of the bright green fresh blood of the pupa of *Pygæra bucephalus* in a thickness of 23 mm.):—

Chief band in the red, 71°–65°, continuous with a less absorption extending to 58°, darkest from 58°5–59°5; a broad band from 52°–48° with the dimmed blue and violet coming through 48°–42°, from which latter point the violet end is absorbed. There is no absorption of the extreme red. A Zeiss's scale is adopted in which 1° = 1/100,000 mm.

Comparing this spectrum with that of true chlorophyll, as seen in two fresh calceolaria leaves, the whole spectrum is shifted towards the violet end in the latter case, with the exception of the end absorption, which extends to 43°. The chief band in the red is 70°–64°5, and then the continuous absorption of metachlorophyll is replaced by two bands: 61°–63° and 57°5–60°, and if anything the former is the darker. The broad band is 47°5–51°, and the dimmed blue and violet 47°5–43°. The chief difference is the continuity of the three bands of the red end in metachlorophyll, and the fact that their darkness is in the order (1) (3) (2) from the red, instead of (1) (2) (3). A similar spectrum (as far as it could be identified by the use of a paraffin lamp) was observed in a clear green fluid from the digestive tract of the larva of *Phlogophora meticulosa*. In yellowish green blood (pupa of *S. ligustri*) the absorption at the violet end is aided by the xanthophyll present, which gives two bands if the thickness of blood be sufficiently small. In some cases a third band is also present. Thus the blood of *S. ligustri* in a thickness of 3 mm. does not give the band of chlorophyll in the red, but shows three bands in the more refrangible half of the spectrum: 48°–50°, 45°–46°25, and 42°–43° the violet end being absorbed at 41°. Between these areas of absorption the spectrum is dimmed. The three bands become less distinct in the above-mentioned order, and the third can only be seen under favourable conditions of light, and appears to be absent in some cases. Mr. Sorby states that a third band, due to another substance, is sometimes present in the xanthophyll spectrum. While the spectrum of metachlorophyll is very constant over a large number of larvæ and pupæ, in the living green pupa of *Ephyra punctaria*, a form of chlorophyll with a rather different spectrum was met with, in which the second band of true chlorophyll is present instead of the continuous absorption, while the third band could not be seen in the slight thickness obtainable. The term "ephyra-chlorophyll" is given to this pigment, which is dissolved in the blood of the pupa. Metachlorophyll, and probably xanthophyll, are united with a proteid in the blood. The addition of ether to green blood brings down the combined pigment and proteid in the form of a green coagulum, from which the ether does not dissolve the metachlorophyll, but gradually takes up the xanthophyll, becoming bright yellow. Alcohol, on the other hand, decomposes the combined proteid and pigments, the coagulum rapidly becoming decolorised, and the xanthophyll passing at once into solution, while the metachlorophyll disappears. Hence it seems that the latter pigment depends upon its association with the proteid for its extreme stability and permanence under the action of light. This permanence is necessary for the larva, since any colour due to derived pigments implies the penetration of light, and often the complete translucence of the whole organism, and, further, there are long periods (at the ecdyses), during which the pigments cannot be renewed, because no food is taken. Then there are the extreme cases of the green Ephyra pupæ, and the green pupæ of *P. machaon*, freely exposed to daylight during two-thirds of the year. It seems certain that the derived pigments are merely protective, and are of no further importance in the physiology of these organisms. Thus it is not probable that there are any marked differences between the physiological processes of the green and brown larvæ from the same batch of eggs, or in the processes of a green larva which has become brown, or *vice versâ*. The blood of larvæ seems to be always acid (and so with all pupæ examined, except *E. punctaria*, of which the blood was neutral, in the only instance in which the blood of this pupa was tested), but I have as yet been unable to obtain a sufficient quantity of blood to determine what acid is present. The blood forms a solid, black coagulum which is due to oxidation, and does not take place when the blood is preserved in the manner described above. The injured parts of larvæ which have healed are black. It is probable that the darkening of pupæ and of the cuticular pigment of larvæ is also due to oxidation. There is great variability in the amount of clot formed and in the rapidity of the process.

*Historical.*—Mr. Raphael Meldola, in the *Proc. Zool. Soc.* for 1873, and in the editorial notes to his translation of Weismann's "Studies in the Theory of Descent," Part. II., "On the Origin of the Markings of Caterpillars," &c., argues very convincingly for the use of plant-pigments by green larvæ. He points out that internal feeders are never green unless their food contains chlorophyll, and that when this is the case (*Nepticula aryacanthella*, &c.) they may be green, although the colour cannot be of any advantage to them. Pocklington (confirmed by Dr. MacMunn) found chlorophyll in the elytra of Cantharides, and Chautard seems doubtful about the same pigment in this situation (*Compt. Rend.*, January 13, 1873, and *Ann. Chim. Phys.*, 5, iii., 1–56). Dr. MacMunn found a band in the red which resembled chlorophyll, by concentrating light on the integument of the larva of *Pieris rapæ* and examining with a micro-spectroscope; but both he and Krukenberg refer the pigment to the larval digestive tract. (See *Reports* of British Association at Southport, 1883, and a letter by Dr. MacMunn to NATURE for the week ending January 10, 1885). It is very unlikely that the green colour of so thick and opaque a larva can be due to its digestive tract, and it is probable that the blood, with its dissolved metachlorophyll, was lost in the manipulation. From memory of the appearance of the larva, and from examining a blown specimen, I should certainly infer that there are also derived pigments in the subcuticular tissues.

*The Relations between the Colour of Phytophagous Larvæ and that of their Food-Plants.*—Entomologists have been long aware of the fact that the colours of many larvæ vary (within the limits of the same species) according to the colour of the plant upon which they are found. Complete references to the observations hitherto recorded upon this point occur in Mr. Meldola's writings (mentioned above). Among the most important of these is a paper by Mr. R. M'Lachlan (*Trans. Ent. Soc.*, 1865, p. 453) in which data are given as to *Eupithecia absynthiata*, which were yellowish when found upon *Senecio jacobæa*, reddish upon *Centaurea nigra*, whitish upon Matricaria. When nearly full grown they were all given *Senecio jacobæa* without altering the colour of the reddish and whitish varieties. From this Mr. M'Lachlan argued (1) that it was necessary for the larvæ to have fed on the one kind of plant from the egg to acquire the resemblance; (2) that the colour is not caused by the food showing through the somewhat transparent integument. Mr. Meldola quotes many instances in which the larva of *S. ligustri* has been observed to vary according to its food-plant (laurustinus, lilac, privet, ash). I have for many years known of the difference between the lilac and privet forms (the latter being of a brighter yellower green than the former, with brighter stripes). In 1884 I bred twelve larvæ from the egg upon privet, and the same number upon lilac. All the privet and six of the lilac larvæ reached maturity, and, without exception, showed the differences indicated above. A more remarkable instance is afforded by *Smerinthus ocellatus*. Mr. Meldola quotes Mr. E. Boscher as finding many yellowish-green varieties of this larva upon *Salix viminalis*, and many bluish-green varieties upon *S. triandra*, similar to those which are well known to occur upon apple. The former varieties possessed the rows of reddish-brown spots which sometimes occur on this variety of the larva. Upon another species of Salix he found instances of both varieties. In 1880 Mr. Boscher conducted some breeding experiments at Mr. Meldola's suggestion, feeding the larvæ from the egg upon *S. triandra, S. viminalis*, and apple, respectively. Only three of the third lot survived, and were all of the bluish-green form. I have also found (*Trans. Ent. Soc.*, Part I., April, 1884) that *S. rubra* and *S. cinerea* produce the yellowish variety, but *S. viminalis* the bluish form, according to my experience. In 1884 I fed five lots of six larvæ each, from the egg, upon apple, crab, *Salix viminalis, S. cinerea*, and *S. rubra*, respectively. On a few occasions *S. babylonica* and *triandra* were substituted for *S. rubra*, and ordinary apple for crab. The eggs were hatched July 15 to 18, and most of the larvæ were full fed by August 23, with the following results:—*Apple*: the five larvæ were typical bluish-green forms. *Crab*: the five larvæ were also typical bluish-green. *S. viminalis*: the four larvæ were not so whitish as the above-mentioned lots, but were almost intermediate. *S. cinerea*: the four larvæ were also intermediate. *S. rubra*: the four larvæ were yellower than any of the others, but were not much beyond intermediate forms. The yellowest was separated on August 14, and fed upon apple, becoming adult August 26, by which time it was rather whiter than any others of the same lot (*S. rubra*).

Thus there was no doubt about the effects produced, but there was a strong tendency all through towards the bluish variety, which the food-plant could only overcome to the extent of producing an intermediate form. The same conclusions were formed by a comparison of larvæ found in the field during 1884. Thus two nearly opposite varieties were found upon the same tree (? *S. ferruginea*, Anderson); an intermediate variety was found upon *S. rubra*, and a bright yellowish variety upon apple. At the same time the great majority of larvæ found were such as I should have anticipated.

Experiments were made upon the younger captured larvæ, which were fed upon food-plants tending towards a different colour. The results were similar to those indicated by the former experiments. Some effect could be produced in an intermediate variety by feeding it for some considerable time upon a food-plant known to have strong tendencies, but no such effect is produced upon a larva with a strongly-marked colour, *i.e.* one with strong tendencies itself, and corresponding with those of the food-plant. But the former experiments show that a very strong larval tendency may be counteracted to the extent of producing an intermediate form by feeding it from the egg upon a food-plant tending strongly in the other direction. When this latter effect has become manifest, it was proved that an appropriate change of the food at a comparatively late period may produce some considerable effect in the direction of the original tendency. The most probable explanation of the above-mentioned facts is that the effects of the food-plant are hereditary, and accumulate when the larvæ of successive generations feed upon plants with the same tendencies. Conversely feeding upon plants with different tendencies, and interbreeding, accounts for the irregularities observed. Thus in the larvæ fed from the egg, it is supposed that the previous generation (or generations) fed upon plants tending towards bluish-green larvæ. The yellowish larva found upon apple must have descended from a line fed upon *S. rubra*, or a plant with the same effects. The localisation of a food-plant would overcome both causes of irregularity, the liability to lay eggs on plants with different tendencies, and the chance of interbreeding between the two varieties.

This explanation is in accordance with the fact that the larvæ are of a very uniform tint upon apple trees in gardens, which are to a certain extent locally separated from the various species of sallow growing by the banks of streams, and in damp lanes and hedgerows. The strong effects produced upon the larvæ by apple, the usual proximity of many trees, and the sluggish flight of the Smerinthi, doubtless all conduce towards the uniformity between the larvæ upon this food-plant. On the other hand, there is the greatest facility for (the observed) irregularity in the results of sallow upon the larvæ, for many so-called species with various tendencies grow close together, so that there must be interbreeding and the deposition of eggs on various species of food-plants, even in the case of very sluggish insects. It is probable that certain conflicting statements as to the effect of the different food-plants upon the larva of *S. ligustri* are to be explained in the same way. As to the structural cause of the variability in these two larvæ, the main factor is a change in the relative amounts of the two derived pigments. Thus there is more xanthophyll in the blood of the pupa of a yellowish *S. ocellatus* than in the other case; and more chlorophyll with less xanthophyll, in the blood of the pupa of *S. ligustri*, from the greener larva fed upon lilac than from one fed upon privet. The result of this adjustment of the relative amounts of derived pigment is to produce a colour which harmonises with the part of the environment imitated—the undersides of the leaves in the case of *S. ocellatus*, the *tout ensemble* of the food-plant in the case of *S. ligustri*. In neither instance can the effects be due to the most direct and simple action of the food itself—the solution of its pigments in their normal proportion showing through the skin. This is disproved by the fact that *S. ocellatus eats* the whole leaf, but *resembles* the underside, and imitates in derived pigments an appearance largely due to texture; further, the effects do not at once follow a change of food, and a strong larval tendency may even cause the rearrangement of the derived pigments, so as to produce an effect *unlike* the leaf. The simple view allows no room for larval tendencies or for delayed effects. It has also been rendered very probable that the effects accumulate during successive generations. In the case of *S. ligustri* there is the additional difficulty that the larval pigment of the oblique stripes is affected by the food-plant as well as the derived pigments. Such effects cannot be explained by any simple theory of phytophagic effects, but it still holds good that phytophagic pigments play a most important part in larval coloration, and afford the chief material which is moulded by some influence—subtler than that which is implied by the term "phytophagic" itself—into likeness to a special part of the environment. The little we know of this influence points towards a nervous circle whose efferent effects are seen in the regulation of the passage of altered plant-pigments through the digestive tract into the blood, and finally the tissues, and in the colour of a certain amount of larval pigment, while the afferent part of the circuit must originate in some surface capable of responding to delicate shades of difference in the colour of the part of the environment imitated This interpretation is rendered unusually difficult by three facts: the gradual working of the process, often incomplete in a single life; the excessively complex and diverse results, and the special character of the stimulus (for it is only the part of the environment imitated which produces any effect —*e.g.* the *undersides* only of the leaves in the case of *S. ocellatus*). During the present year I hope to experiment further upon the subject, and I have a large number of living pupæ of *S. ocellatus*, with the life-histories of their respective larvæ carefully noted.

**Chemical Society**, May 7.—Dr. Hugo Müller, F.R.S., President, in the chair.—The following papers were read:—On some points in the composition of soils; with results illustrating the sources of fertility of Manitoba prairie soils, by Sir J. B. Lawes, Bart., LL.D., F.R.S., F.C.S., and J. H. Gilbert, Ph.D., LL.D., F.R.S., V.P.C.S.—Researches on the relation between the molecular structure of carbon compounds and their absorption spectra, by Prof. W. N. Hartley, F.R.S. In continuation of the author's previous researches (*Trans.*, 1881, 57-60 and 111-128; 1883, 676-678), measurements have been made of the wave-lengths of the rays absorbed by the following substances:—(1) Aromatic hydrocarbons: benzene, the three xylenes, and naphthalene. (2) Aromatic tertiary bases and their salts: pyridine, picoline, quinoline, and their hydrochlorides. (3) Addition products of tertiary bases and salts: piperidine, tetrahydroquinoline, and its hydrochloride. (4) Primary aromatic bases or amido-derivatives and salts thereof: ortho- and para-toluidine and their hydrochlorides. In the preparation of solutions, a milligram-molecule, that is, the molecular weight in milligrams, was dissolved in 20 c.c. of a [illegible] solvent, and made up to a given volume, generally 20 c.c. In this way molecular weights were made to occupy equal volumes. Photographs of the absorption spectra were taken through definite thicknesses of solution. The lines of tin, lead, and cadmium were used as reference; the positions of the bands were measured on the photographs by means of an ivory rule divided into hundredths of an inch, and these measurements were reduced by means of [illegible] oscillation frequencies and wavelengths. As far as possible the absorption curves are drawn to a uniform scale. These curves indicate the *molecular selective absorption* of each substance. The following deductions are drawn:—When an atom of nitrogen is substituted for an atom of carbon in the benzene or naphthalene nucleus, the property of selective absorption is still retained. When the condensation of the carbon and nitrogen in the molecule of a benzenoid compound or [illegible] base is modified by the addition of an atom of hydrogen to each atom of carbon and nitrogen, the power of selective absorption is destroyed. When the condensation of the carbon in pyridine is modified by the combination therewith of four atoms of hydrogen, the intensity of the selective absorption is reduced, but not destroyed. A very pure specimen of quinoline [illegible] gave an absorption curve identical with that of quinoline prepared synthetically by Skraup's method. It may further be added that molecular actinic absorption of a salt is different from that of the organic base which it contains, although the acid may have no absorptive power by itself. Sometimes the difference is very great, but the area [illegible] curve of the salt is always less than that of the base. Molecules vibrate as wholes or units, and the fundamental vibrations give rise to secondary vibrations which stand in no obvious relation to the chemical [illegible] of the molecules, whether these are atoms or smaller molecules. Hence it appears that molecules have distinct and individual periods which cannot be truly represented by our usual chemical formulæ, since these only symbolise or [illegible] reactions and physical properties, and fail to express any relation between chemical and physical properties.—[illegible] the action of [illegible] zinc compounds on organic bases, [illegible], by Dr. J. H. Gladstone, F.R.S., and Alfred Tribe.—On the [illegible] alteration of the [illegible] of [illegible], by Thomas Turner, Assoc.R.S.M.—On the existence of a [illegible] anhydride in the gaseous state, by Prof. G. Lunge.—On the reaction between nitric oxide and oxygen under varying conditions, by Prof. G. Lunge. Experimental evidence is given for the following conclusions:—(1) That when nitric oxide is mixed in the dry state with an excess of oxygen they combine exclusively, or nearly so, to form $NO_2$. (2) Dry NO and $O_2$, with an excess of the former, yield a large proportion of $N_2O_3$ along with $NO_2$, both in the state of gas. (3) In the presence of water, NO in the presence of an excess of $O_2$ is altogether changed into $HNO_3$. (4) If NO and O meet in the presence of concentrated sulphuric acid, nothing but $HNO_2$ is formed, even with the greatest excess of oxygen [illegible]:—

$$4NO_2H_2 + 2NO + O_2 = 4SO_2(OH)(ONO) + 2H_2O.$$

The [illegible] of [illegible] the [illegible] of the [illegible] presence of [illegible] [illegible] the $NO_2$, and [illegible] as the carrier of oxygen, and [illegible] as long as [illegible] quantity of $NO_2$ is present, no nitric oxide [illegible], the following being the reaction whereby the sulphuric acid is formed:—

$$2SO_2 + N_2O_3 + O_2 + H_2O = 2SO_2(OH)(ONO),$$
$$2SO_2(OH)(ONO) + SO_2 + 2H_2O = 3SO_2(OH)_2 + N_2O_3.$$

**Anthropological Institute**, May 12.—Francis Galton, F.R.S., President, in the chair.—The election of R. Bowdler Carter, F.R.G.S., was announced. The Earl of Northesk exhibited a collection of Maori worked jade.—Mr. Seppings Wright exhibited a portrait in oils of King Tawhiao, in native costume.—Mr. J. H. Kerry-Nicholls, F.R.G.S., read a paper on the origin, and manners and customs of the Maori race. The origin of the Maoris and the date of their arrival in New Zealand is unknown. The natives refer to Hawaiki as the fatherland of their race, but there is no reliable evidence to show where this land was situated. The lecturer believed that the Maoris emigrated from the Tonga islands to New Zealand, and referred to the resemblance between the two races, and to the affinity of the two languages. The word *Tonga* occurred no less than sixteen times in the Maori tongue. The natives of the two countries when they met could converse with but little difficulty. The Maoris are of Malay stock, and [illegible] gradual spread of that race through the eastern is[illegible] Pacific to the more southern groups. The race is gr[illegible] decrease. In Cook's time (1769) the whole native [illegible] was estimated to exceed 100,000. In 1859 it only a[illegible] 56,000. In 1881 the number had decreased to 44,0[illegible] 24,370 were males and 19,729 females. Calcula[illegible] same rate of decrease, about the year 2000 the Maori [illegible] be extinct. The principal diseases conducing to this [illegible] phthisis, chronic asthma, and scrofula, the two first [illegible] brought about by a half savage, half civilis[illegible] life, and the latter from maladies contracted sinc[illegible] contact with Europeans. The native religion still [illegible] widespread influence over the people; it consists of [illegible] polytheism, a worship of elementary spirits a[illegible] ancestors. They have a vague conception of a Supr[illegible] and believe in a *Reinga*, or heaven, and a *Po*, or H[illegible] Maoris are divided into tribes whose members are [illegible] gether by the strictest union. The ownership of the [illegible] tribal tenure, and each tribe holds a communal [illegible] lands, forests, cultivations, and fisheries. The [illegible] together in villages, and each *hapu*, or tribal family, [illegible] portion of land sufficient to meet its immediate req[illegible] The Maoris own about 15,000,000 acres of land in [illegible] Island, not yet alienated to Europeans. The owner[illegible] [illegible] was secured to the natives under the treaty of [illegible] made in 1840. The tribes are governed by heredit[illegible] In 1858 a king was elected by consent of the tribes [illegible] Potatau the First. He was succeeded by [illegible] Te Pakepake Te Pane I. Karai Tea B[illegible] Wherowhero Tawhiao, or Potatau II. This was the [illegible] last year visited this country.

EDINBURGH

**Royal Society**, May 18.—[illegible] Sang, LL.D., Vice-President, in the chair.—The first instalment of a paper by Prof. [illegible] on the Heavens, was read. The chief [illegible] was to [illegible] the theory of the [illegible] intensity of [illegible] [illegible] at any one point as depending upon the [illegible] [illegible] of that point.—In a paper on the [illegible] [illegible] in a thermo-electric circuit, [illegible] [illegible] the [illegible] and [illegible] [illegible] order. He showed what is the [illegible] most probable arrangement of [illegible] in the circuit, [illegible] experiments remain to be made in order [illegible] point.—A paper by Mr. [illegible] [illegible] [illegible] [illegible] pure water.

PARIS

**Academy of Sciences**, May 18.—M. Bouley, [illegible] in the chair.—On the results of [illegible] [illegible] in the determination of certain [illegible] [illegible] by M. M. Loewy.—[illegible] [illegible] during the months of April and May, by M. [illegible] lowering of the temperature, [illegible] [illegible] [illegible], is rightly attributed by [illegible] [illegible] [illegible] months of April and May.—Note on the [illegible] [illegible] [illegible] against yell[illegible] [illegible] by M. Hauser. This [illegible] [illegible] Domingos Freire, [illegible] [illegible] [illegible] under the control of the Government. [illegible] 1883, to [illegible] 1100 [illegible] [illegible] of life have been [illegible] [illegible] with the [illegible] [illegible] [illegible] for the [illegible] [illegible] [illegible] were administered in [illegible] [illegible] had a few hours before proved fatal [illegible] [illegible]. Yet no [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] have been [illegible] [illegible] results.—Anatomical study of the [illegible] of a sp[illegible] whale, by M. Pouchet.—Note on the [illegible] regarded as the prime motor of the cerebral mechan[illegible] [illegible] centre of localisation for speech, the reasoning [illegible] and the will, by M. Brot. From his studies [illegible] [illegible] the author concludes, against the generally accepted [illegible] that the third left frontal convolution is not the [illegible] centre of speech, which he localises in the [illegible] tuberances. In the same region he also [illegible]

…e localised, so that even slight lesion… of the annular protuberance destroy… …eech and of reason. He accordingly… …ychic faculties are located in the cerebral… only of the organs of sense.—Note on… …'s motions (rolling and pitching) on the… …a with the Renouf mercury level, by… …marks on the observations of the planet… present year with the [illegible] refractor of… …, by M. E. L. Trouvelot.—Note on the… of vibration for elastic circular plates… …n the production of induction sparks at… on its application to the study of the… Demarçay.—Composition and heat of… coal from the Altendorf mine of the… …heurer-Kestner.—Note on the [illegible] of the cephalopods, by M. L. Vaillant… …y of this organ, the use of which [illegible] …he author infers that it should [illegible] …ary arm.—A study of the [illegible] …er from their respiration, by MM. [illegible] …—By "chlorophyll [illegible]" the… …ecomposition of the carbonic acid of… green parts of vegetables… they claim to have separated from… …e studied in connection with it… of their researches on the two [illegible] …apart.—Note on the [illegible] …nd in the nasal, pharyngial, [illegible] …, by M. [illegible] [illegible]

## Berlin

…arch 8.—[illegible]

[illegible]

…cated through a metallic wire with one half of a quadrant electrometer, and on the other side through a second loop with a third mercury cup. The second half of the electrometer and the third mercury cup were in permanent communication with the earth. The two loops could alternately be raised out of the quicksilver by [illegible] and let down. If the first loop was [illegible] conducted to the earth, the [illegible] on the other hand, [illegible]

[illegible]

Reale Accademia dei Lincei [illegible]

[illegible]

time have been united together and formed a single deposit, and shows how that excludes the hypotheses that they were formed in the place where they are now found, and that they are derived from deposits anterior to the period of volcanic activity. —On the relations between the maxima and minima of the solar protuberances, and the maxima and minima of the diurnal oscillation of the declination magnet. Prof. Tacchini, after giving an account of his own researches already published, on the maxima and minima of the sunspots and solar protuberances, referred to the observations of Prof. Schiapparelli on the values of the range of diurnal oscillation of the declination needle, and from the comparison of the two sets of observations, it appears that of late years the connection between the solar protuberances and terrestrial magnetism is more strikingly manifest. These and other similar observations, Prof. Tacchini added, corroborate the idea entertained by himself and some others, that electricity plays the chief part in the solar protuberances, and that electricity is able to produce corresponding magnetic disturbances on our globe. It may therefore be inferred with certainty that the phenomena of the sunspots, the solar protuberances, and terrestrial magnetism are closely connected together, and that by means of one of these sets of phenomena it is possible to determine with tolerable precision the epoch of the other two. In dealing, however, with phenomena of rather long period continuous observations for at least half a century are necessary to make our researches complete.—On the spectroscopic observations of the limb of the sun and the solar protuberances made in 1881 and 1884 at the Royal Observatory of the Capitol.—Prof. Respighi laid before the meeting some considerations of his own, based on observations made in his own observatory, and leading him to conclusions different from those of Prof. Tacchini. He maintains that the maximum of solar protuberances occurred towards the end of the third quarter of 1881. Holding that the sun-spots are due to partial cooling of the surface of the sun, and the protuberances to the escape of gases from the interior, Prof. Respighi believes that such perturbations are not of a nature to occur in periods, even though they retain a certain relation among themselves, and still less can he admit any connection between the maxima of the solar protuberances and the elements of terrestrial magnetism.—Meteorological observations made by Signor P. Orlandi, a physician of Rome, during the years 1809–1820. Signor Narducci called attention to a manuscript in the Biblioteca Angelica, containing some interesting medico-meteorological observations made by Signor Orlandi, a medical man belonging to Rome, between the years 1809 and 1820. These observations are copious and complete, having been made daily. They also include notices of movements of the earth's crust and inundations of the Tiber. Signor Narducci mentioned that Dr. Orlandi was a man of science and writer of great renown in his time. Large extracts from the observations of Orlandi are to be published in the *Annals* of the Central Office of Meteorology, and they will thus be able to be compared with those published by distinguished astronomers belonging to the same epoch.—On the last and recent maximum of sun-spots and solar protuberances. Prof. Riccò gave an account of his own observations made at Palermo on the phenomenon of the solar protuberances, which was so important on account of its coincidence in time with very singular manifestations of the solar maculæ. Prof. Riccò deduced from his own observations, harmonising, as they do, with those of Prof. Tacchini, that, starting from the last maximum in the period of eleven years, the number of the protuberances went on increasing till 1881, when a first maximum occurred. It was further verified that the absolute maximum fell between the end of 1803 and the beginning of 1804, and that on that occasion the maximum of protuberances continued beyond that of the sun-spots. Finally, leaving out of account secondary oscillations, Prof. Riccò asserted that a parallelism may be observed between the frequency of sun-spots and protuberances, the principal maxima and minima of both phenomena [illegible] the relation between the [illegible] sun-spots and the maxima and [illegible] the declination needle observed at [illegible] made a comparison between [illegible] of [illegible] 1877–84 [illegible] needle [illegible] mirror- [illegible] per- [illegible] and [illegible] the mag-

netic influence of th[illegible]
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## Diary of Societies

LONDON

*THURSDAY*, MAY 28.

SOCIETY OF TELEGRAPH ENGINEERS, at 8.—Ship Lighting by Glow-Lamps, embodying Results of Trial for Economy in H.M.S. *Colossus*: B. J. Farquharson.—Electric Lighting at the Forth Bridge Works: J. N. Schoolbred, B.A.

ROYAL INSTITUTION, at 3.—Poisons: Prof. C. Meymott Tidy.

*FRIDAY*, MAY 29.

ROYAL INSTITUTION, at 9.—Mechanical Production of Cold, and Effects of Cold on Microphytes: J. J. Coleman and Prof. J. G. McKendrick.

*SATURDAY*, MAY 30.

ROYAL INSTITUTION, at 3.—"The Teaching of the Twelve Apostles"—an Ancient Document—with Illustrations from the Talmud: Rev. C. Taylor.

*MONDAY*, JUNE 1.

SOCIETY OF CHEMICAL INDUSTRY, at 8.

ROYAL INSTITUTION, at 5.—General Monthly Meeting.

*TUESDAY*, JUNE 2.

ZOOLOGICAL SOCIETY, at 8.30.—On the Anatomy of the Sondaic Rhinoceros: Frank E. Beddard, F.Z.S., and F. Treves, F.Z.S.—On Megalapteryx hectori: Dr. Julius von Haast, C.M.Z.S.—On the Birds collected during the Voyage of the Yacht *Marchesa*. Part IV. On the Collection of Birds from Celebes. Part V. On the Collection of Birds from the Moluccas: Dr. Guillemard, F.Z.S.

ROYAL INSTITUTION, at 3.—Digestion and Nutrition: Prof. Gamgee.

*THURSDAY*, JUNE 4.

LINNEAN SOCIETY, at 8.—Vernation and Development of Foliage from Buds: Rev. George Henslow.—Supplementary Notes on Restiaceæ: Dr. Maxwell Masters.—Occurrence of Lycopodites Vanuxenæ in Britain, with Remarks on its Affinities: R. Kidston.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—On the Constitution of the Haloid Naphthaline Derivatives: Prof. Meldola.—On the Action of Ammonia on Aceto-Acetic Ethyl Ether: Norman Collie, Ph.D.

ROYAL INSTITUTION, at 3.—Poisons: Prof. C. Meymott Tidy.

*FRIDAY*, JUNE 5.

GEOLOGISTS' ASSOCIATION, at 8.—On some recently discovered Insecta and Arachnida from Carboniferous and Silurian Rocks: Herbert Goss, F.L.S.—Notes on the Superficial Deposits of North Kent: J. G. Goodchild, F.L.S.

ROYAL INSTITUTION, at 9.—Liquid Air: Prof. Dewar.

*SATURDAY*, JUNE 6.

ROYAL INSTITUTION, at 3.—"The Teaching of the Twelve Apostles"—an Ancient Document—with Illustrations from the Talmud: Rev. C. Taylor.

Printed by [illegible] 8, Bread Street Hill, Queen Victoria Street, in the City of London, and Published by [illegible] and 30, Bedford Street, Covent Garden.—THURSDAY, June 4, 1885.

INDEX NUMBER.

# NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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

No. 815, Vol. 32] THURSDAY, JUNE 11, 1885 [Price One Shilling

Registered as a Newspaper at the General Post Office] 

DAY, JUNE 11, 1885

## RWIN MEMORIAL

he unveiling of a statue is attended
at all comparable with that which
emony as performed last Tuesday
the Natural History Museum. If
is to be estimated by the measure
enced the thoughts of men it is
ion that the greatest man of our
rwin. As Prof. Huxley remarked
ularly judicious and well balanced
work has not only reconstructed
but has spread with an organising
st every department of philosoph
s not merely the greatness of the
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an interest so unique. It was
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nes of simple grandeur as those
intellectual nature. It therefore
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ht. And it was this reflection
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s and the Archbishop of Canter
extremes of Radicalism and [illegible]
not too much to say that there is
n an occasion on which so many
site ways of thinking have met to
ement upon a man to whom they
lue. The international [illegible]
n have found a more worthy [illegible]
has been placed: [illegible]
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tal, it must have been the [illegible]
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which it represented, [illegible]
ays and universally [illegible]
of all that is greatest in [illegible]
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e itself, we have only to [illegible]
lified praise. It is, in the [illegible]
oble work of art. The [illegible]
ified, but also natural and [illegible]
ing of the head and face [illegible]
e portrait is admirable. The only
lance has reference to the hands,
bear the smallest resemblance
ut are of a kind which, had they
, would have rendered [illegible]
much of his work. Although the

misrepresentation [illegible] matter to be deplored, it is not one for which the artist can be justly held responsible. Never having had the advantage of seeing Mr. Darwin, Mr. Boehm has only to be congratulated upon the wonderful [illegible] which has attended his portraiture of the face and [illegible]; the hands were no doubt supplied by guess-work, and therefore we have only to regret that the guess did not happen to have been more fortunate.

The following is the address made by Prof. Huxley, in the name of the Darwin Memorial Committee, on handing over the statue to H.R.H. the Prince of Wales, as representative of the Trustees of the British Museum:—

Your Royal Highness,—[illegible] three years since the [illegible] of the death of our famous [illegible] [illegible] manifestation of [illegible], but throughout the [illegible], which [illegible] not, is without precedent in the [illegible] of scientific biography.

The [illegible] of emotion [illegible]

[illegible]

Royal Society, for the purpose of considering what further steps should be taken towards the same end.

It was resolved to invite subscriptions, with the view of erecting a statue of Mr. Darwin in some suitable locality; and to devote any surplus to the advancement of the biological sciences.

Contributions at once flowed in from Austria, Belgium, Brazil, Denmark, France, Germany, Holland, Italy, Norway, Portugal, Russia, Spain, Sweden, Switzerland, the United States, and the British Colonies, no less than from all parts of the three kingdoms; and they came from all classes of the community. To mention one interesting case, Sweden sent in 2296 subscriptions "from all sorts of people," as the distinguished man of science who transmitted them wrote, "from the bishop to the seamstress, and in sums from five pounds to two pence."

The Executive Committee has thus been enabled to carry out the objects proposed. A "Darwin Fund" has been created, which is to be held in trust by the Royal Society, and is to be employed in the promotion of biological research.

The execution of the statue was entrusted to Mr. Boehm; and I think that those who had the good fortune to know Mr. Darwin personally will admire the power of artistic divination which has enabled the sculptor to place before us so very characteristic a likeness of one whom he had not seen.

It appeared to the Committee that, whether they regarded Mr. Darwin's career or the requirements of a work of art, no site could be so appropriate as this great hall, and they applied to the Trustees of the British Museum for permission to erect it in its present position.

That permission was most cordially granted, and I am desired to render the best thanks of the Committee to the Trustees for their willingness to accede to our wishes.

I also beg leave to offer the expression of our gratitude to your Royal Highness for kindly consenting to represent the Trustees to-day.

It only remains for me, Your Royal Highness, my Lords and Gentlemen, Trustees of the British Museum, in the name of the Darwin Memorial Committee, to request you to accept this statue of Charles Darwin.

We do not make this request for the mere sake of perpetuating a memory; for so long as men occupy themselves with the pursuit of truth, the name of Darwin runs no more risk of oblivion than does that of Copernicus or that of Harvey.

Nor, most assuredly, do we ask you to preserve the statue in its cynosural position in the entrance hall of our National Museum of Natural History as evidence that Mr. Darwin's views have received your official sanction; for science does not recognise such sanctions, and commits suicide when it adopts a creed.

No, we beg you to cherish this Memorial as a symbol by which, as generation after generation of students of Nature enter yonder door, they shall be reminded of the ideal according to which they must shape their lives, if they would turn to the best account the opportunities offered by the great institution under your charge.

The following reply was made by H.R.H. the Prince of Wales:—

PROF. HUXLEY AND GENTLEMEN,—I consider it to [be] a high privilege to have been deputed by the unanim[ous] wish of my colleagues, the Trustees of the British [Mu]seum, to accept, in their name, the gift which you [have] offered us on behalf of the Committee of the Dar[win] Memorial. The Committee and subscribers may [be] assured that we have most willingly assigned this hon[our]able place to the statue of the great Englishman who [has] exerted so vast an influence upon the progress of th[ose] branches of natural knowledge the advancement of w[hich] is the object of the vast collections gathered here. [It] has given me much pleasure to learn that the memo[rial] has received so much support in foreign countries tha[t it] may be regarded as cosmopolitan rather than as st[rictly] national; while the fact that persons of every condi[tion] of life have contributed to it affords remarkable eviden[ce] of the popular interest in the discussion of scienti[fic] problems. A memorial to which all nations and [all] classes of society have contributed cannot be more fi[tly] lodged than in our Museum, which, though national, [is] open to all the world, and the treasures of which are [at] the disposal of every student of nature, whatever [the] condition or his country, who enters our doors.

## CLAUS'S ELEMENTARY TEXT-BOOK O[F] ZOOLOGY

*Elementary Text-Book of Zoology.* Special Part: M[ollusca] to Man. By Dr. C. Claus. Translated a[nd] edited by Adam Sedgwick, M.A., Fellow and Lectu[rer] of Trinity College, Cambridge, with the assistance [of] F. G. Heathcote, B.A., Trinity College, Cambrid[ge.] (London: W. Swan Sonnenschein and Co., 1885.)

THE first ten pages of this volume are devoted to t[he] Mollusca and Tunicata, and the remarks offered [in] NATURE [illegible] upon Vol. I. app[ly] equally well here.

The information imparted is fully up to date, and t[he] Tunicate section may be taken on the whole, as a typ[e] of that well-balanced and [illegible] ind[i]spensab[le] in a work of this order.

The [illegible] the mollusc [illegible] and typic[al] [illegible] throug[h] [illegible] the gre[at] groups. No better [illegible] quoted tha[n] those [illegible] where characte[r] [illegible] of th[e] [illegible] united, and, althoug[h] [illegible] emphasi[s] [illegible] *pro* [illegible] applicable to bot[h] the living and extinct forms.

It is disappointing to find the [illegible] digestiv[e] [illegible] spoken of [illegible] being mad[e] of the researches of Weber, Barfurth, and others, into i[ts] structure and functions. It is highly desirable in a boo[k] of this kind that any statement [illegible] animal[s] such as are likely to fall into the hands of the averag[e] student, should be absolutely reliable. It cannot b[e] said (p. 52) that the shell of Aplysia is covere[d] by two lobes of the foot," and the beginner would soo[n] find that Lomax and Arion are not the only commo[n] Gasteropods in which the pedal gland [illegible] while made on p. 27 he would never infer [illegible]don shell is destitute of teeth. The [illegible] somewhat less commonplace than [illegible] be found in our museums, and no [illegible] this volume of the exceptional [illegible] in fact, the beginner would rather [illegible]ptions given that it is a normal [illegible]ss pardonable are the inadequate [illegible]e rest of the Cephalopod group, [illegible] unfortunate in their reference to [illegible]e extinct forms. The [illegible] [illegible]chi go without a mention.

[illegible] of Prof. Moseley's recent d[illegible] adduced on p. 34 for the absence of [illegible] Chiton are of some interest, as a [illegible] too sweeping generalisations.

[illegible] Molluscoidea there is a bare men[illegible]dopleura, and we are at a loss [illegible] to the important [illegible] should have been omitted in the [illegible]

[illegible] portion of the work which [illegible] 31 pages are devoted to the Ver[illegible] [illegible]

That that [illegible] of the work falls short of the needs of the English-speaking student is certain, especially as it is [illegible] far behind other manuals current in the tongue. [illegible] the bare enumeration of which would be superfluous, are predominant on all hands, and the retention of the [illegible] and [illegible] Hydrosauria [illegible] Sirenia [illegible] with [illegible] We heartily commend the invertebrate portion of the work to the student. He may find that which follows [illegible] but he need be [illegible] that it [illegible] on all points and absolutely [illegible] importance [illegible] of the more [illegible] should a [illegible] of the work be [illegible] it is to be hoped that the [illegible]

[illegible]

matters of affinity between living birds and reptiles should be overlooked. The characters of the mesotarsal joint and of the tarso-metatarsus are imperfectly defined, and those of the pelvis of Apteryx ignored; while among the extinct forms, the Dinosauria—several of whose features we are told on p. 220 "recall mammals, especially the Pachydermata"—the Ornithoscelida, and the Odontornithes, are all dismissed in a few lines. Little would the student, taking his text from this work, dream of the noble array of direct affinities to be found among even living birds and reptiles.

The translators have evidently realised that the statements reproduced on pp. 198 and 215, concerning the lizard's quadrato-jugal arcade are contradictory, and a supplemental paragraph of their own on p. 198 only serves to increase the perplexity. Chapter IX. is devoted to the Mammalia, but 69 pages of it starting with the assertion (p. 282) that the Monotremes' hemispheres are "still smooth," is poor fare. The cutting down of every group of mammals to a minimum would be in a sense pardonable, if only concise diagnoses were given such as should cover the broad lines of modification; but when, bearing in mind certain of the more glaring defects of this chapter referred to at the outset, we read (p. 306) that the Whales approach the Ungulates "through the Sirenia," and that the "Sirenia are intermediate, so far as their form is concerned, between the whales and seals" (p. 309), our faith is shaken in that which remains. There is the usual confusion concerning the position and movements of the hind-limbs of the Pinnipedia, the condition of the parts in the eared seals being entirely overlooked. In diagnosing a group of animals for purposes such as are here required, where the living and the extinct are both under consideration, it is but fair to assume that special attention should be paid to the hard parts, the teeth not excepted; but we look in vain for statements such as shall embody the extremes of modification of these parts in any one group of living mammals—for example, in dealing with the Rodents the utmost sketchiness prevails, the modifications of even the fibula are not hinted at, and while Hydromys is placed among the mice with grinders $\frac{2}{2}$, Heliophobius is not mentioned. No wonder, then, that Hyœmoschus should go unnoticed, that Hyrax should here be found under the order Proboscidea (with a caution, it is true), and that the Carnivora, Cheiroptera, Lemurs, and Primates should be treated with disrespect. We are told (p. 301) that the epipubes support the marsupial pouch, and there is no reference at all to the most important facts concerning the marsupial dentition. There is something so specifically English about gross vertebrate anatomy that we search in vain for bare mention, not to say recognition, of discoveries bearing upon the above, and many similar matters of first importance.

From what has been said it will be obvious to English students that the vertebrate section of Prof. Claus's manual is weakest where works on the subject already current in our language are strong; and, with all respect to our Continental cousins, we are of opinion that the market is becoming overstocked with translations such as that before us. Their period is past; the English student in earnest must sooner or later fit himself for access to the originals, and the repeated production of English versions serves only to prolong the fatal day. We cannot but regret, though reluctantly, the publication of this work in its present form, the more so as it threatens to encourage the growing tendency to under-estimate the value of gross vertebrate anatomy, a field of labour essentially English, but still the very backbone of zoological science.

Mr. Sedgwick has performed the task of translation with a thoroughness and skill deserving the thanks of his countrymen. Some few passages in the original, at best clumsy, might have been better rendered than they are; and settings such as the "above together," on p. 16, might be advantageously modified. The translators give in Vol. I. a list of English synonyms for the geological terms employed in the original, but these are not always adopted in Vol. II.; thus we find the Jurassic beds referred to again and again as the "Jura," a rendering certainly not that of English geologists. The original illustrations are for the most part excellent, and those which remain are admirably selected. That on p. 284, however, certainly does not illustrate the anatomy of the human ear, and the figures selected from the classic of Johannes Muller, in illustration of the anatomy of the lamprey's skull (p. 154) do scant justice to the work of a great genius, and he a German. G. B. H.

## CLIFFORD'S EXACT SCIENCES

*The Common Sense of the Exact Sciences.* By the late W. K. Clifford. (London: Kegan Paul, Trench, and Co., 1885.)

ONCE more a characteristic record of the work of a most remarkable, but too brief, life lies before us. In rapidity of accurate thinking, even on abstruse matters, Clifford had few equals; in clearness of exposition, on subjects which suited the peculiar bent of his genius and on which he could be persuaded to bestow sufficient attention, still fewer. But the ease with which he mastered the more prominent features of a subject often led him to dispense with important steps which had been taken by some of his less agile concurrents. These steps, however, he was obliged to take when he was engaged in exposition; and he consequently gave them (of course in perfect good faith) without indicating that they were not his own. Thus, especially in matters connected with the development of recent mathematical and kinematical methods, his statements were by no means satisfactory (from the historical point of view) to those who recognised, as their own, some of the best "nuggets" that shine here and there in his pages. His *Kinematic* was, throughout, specially open to this objection;—and it applies, though by no means to the same extent, to the present work. On the other hand, the specially important and distinctive features of this work, viz. the homely, yet apt and often complete, illustrations of matters intrinsically difficult, are entirely due to the Author himself.

The Editor, in his *Preface*, tells us the whole story of the difficulties he had to face in completing the volume for press. All will sympathise with him when they find that he had to furnish one entire chapter, and large portions of two others, in addition to thorough revisal of the whole. For Clifford's style is here entirely *sui generis.* The track to his homely yet hardy expositions often lay in regions where but a single careless step would have led to the Inconsequent or the Ridiculous. And one who tries to imitate him successfully must possess not only his nerve, but also his wonderful agility and resource of every kind. We shall therefore say no more on the subject of the Editor's additions to the volume, than that his daring has met with comparative immunity from the more obvious dangers of his course.

The original title of the work was, we are told, *The First Principles of the Mathematical Sciences Explained to the Non-Mathematical.* There can be no doubt that the new title is much to be preferred. We do *not* believe that the Mathematical Sciences, even in their first principles, can be explained to the Non-Mathematical. Whosoever understands the explanation has, to that extent at least, *become* Mathematical in the very act of understanding. But this observation is made on the assumption that Non-Mathematical means "uninstructed in mathematics." There is another sense which the term may bear:—viz. "incapable of understanding mathematics." Among mankind there are none who more persistently claim the almost exclusive possession of the highest grade of human intelligence than do the (so-called) Metaphysicians. How many of these self-accredited possessors of all but superhuman acuteness have been able to cross the *Pons Asinorum?* How many have been able to understand even the *objects* (not the *processes*) of mathematical investigation? When the answer comes (it probably will not come, as it *can not* come in a favourable form) it will be time to comment on it.

The chief good of this book, and in many respects it is very good, lies in the fact that the versatility of its gifted author has enabled him to present to his readers many trite things, simple as well as complex, from so novel a point of view that they acquire a perfectly fresh and unexpected interest in the eyes of those to whom they had become commonplace. Surely this was an object worthy of attainment! But it is altogether thrown away on the non-mathematical, to whom neither new nor old points of view are accessible.

Considering the circumstances under which the book has been produced, it would be unfair to comment on the smaller errors. But there are a few very awkward statements, and one or two grave errors, which ought not to have escaped correction. We give an example of each class. Thus, p. 16, the following statement is quite unnecessarily puzzling:—

"If we can fill a box with cubes whose height, length, and breadth are all equal to one another, the shape of the box will be itself a cube."

This out-germans German itself in the displacement of the words from their natural position in English; and, at first sight, seems to be nonsense. Read it, however, thus:—

"If we can fill with cubes a box whose height, &c. . . . the shape of the box itself will be a cube,"

and the absurdity, suggested by the collocation, disappears.

Again, p. 66, what are we to make of the following, standing, as it does, without comment or explanation of any kind?—

"The statement that a thing can be moved about without altering its shape may be shown to amount only to this, that two angles which fit in one place will fit also in another, no matter how they have been brought from the one place to the other."

Several most serious qualifications must be imposed upon this statement before it can possibly be accepted as true.

The chapter on *Motion* properly forms a part of this work, so far at least as kinematics is concerned. But it seems to be a mistake to conclude it with a few editorial sentences on the *Laws of Motion.* For here we have a perfectly new subject, and one which would require at least a full chapter to itself. It is probable enough that, at some period of his life, Clifford imagined that it might be possible to get rid of the idea of matter as well as of that of force, and so to reduce Dynamics to mere Kinematics. He never so expressed himself to me. But purely physical subjects were, properly speaking, beyond his sphere; his ideas about them were always more or less vague, because always of a somewhat transitional character, and were much modified at times by the momentary turn of his philosophical speculations. We are told in a foot-note to the first page of the *Preface* that Clifford left his *Kinetic* (a companion volume to his Kinematic) *in a completed state.* Surely, keeping this in view, the introduction of Laws of Motion into the present work was superfluous.

This foot-note unfortunately strikes a jarring chord at the very first opening of the book. We are told that "more serious delay seems likely to attend the publication" of Clifford's *completed* MS.; this is followed by a mysterious species of protest or remonstrance. Clifford could never have written in this vein. He would either have kept silence, or have blurted out the whole truth. Mystery and insinuation were not weapons of his, and should not be employed in connection with his name.[1]

P. G. Tait

## OUR BOOK SHELF

*New Commercial Plants and Drugs.* No. 8. By Thos. Christy, F.L.S., &c. (London: Christy and Co., 155, Fenchurch Street, 1885.)

The eighth number of Mr. Thos. Christy's "New Commercial Plants and Drugs" has recently appeared, and the contents are of a similar character to those that have preceded it, the most recently introduced commercial products derived from the vegetable kingdom being enumerated and what has been written about them brought together. The first plant referred to in the book is of course the Kola nut (*Cola acuminata*), as being one of the most important, or at least one that has attracted a very large share of attention during the past year. This article is illustrated by a coloured plate of the fruit and seeds of this species, as well as of the Guttiferous plant known as the Bitter Kola. Besides having the property of cleansing or purifying and thus rendering wholesome stagnant or foul water, it has also been used for clarifying beer and spirits. One of its most remarkable properties is in restoring the senses after partaking to excess of intoxicating drinks. The most recent application of the Kola nut, however, is in the preparation of a paste for mixing with cocoa or chocolate, which it is said to improve "both in strength and flavour to an astonishing degree." It is considerably more nutritious and strengthening; so much so indeed "that a workman can, on a single cup taken at breakfast time, go on with his work through the day without feeling fatigued."

In consequence of this and many other medicinal

[1] In Nature, vol. xxxii. p. 4, Mr. Tucker intimated that Macmillan and Co. would publish the remaining mathematical p[illegible] late Prof. Clifford.—Ed.

virtues the Kola nut is considered to have a great future before it in European commerce, and is consequently strongly recommended to the notice of planters in our colonies for extensive cultivation. With regard to the preservation of the germinating properties of the seeds, Mr. Christy says he has received them in good condition, both in baskets and barrels lined with the leathery leaves of a tree known as the "bail tree." Some received in dry loam arrived as fresh as when they were gathered, and of some that arrived eighteen months since, the bulk is stated to be perfectly fresh and retaining still their beautiful red colour.

From a list of fifteen species of *Myristica*, the fruits or seeds of which are described, the value of the nutmeg genus is shown, especially as oil seeds. Seeds new to commerce are frequently arriving in the Liverpool and London markets, intended for the expression of oil and for the preparation of oil cake. Such seeds are of a very varied character and belong to widely different natural orders, and not long since those of *Myristica surinamensis* came into Liverpool under the name of African nuts. Upon analysis they were found to contain a large quantity of solid oil or fat with an agreeable taste, and but little, if any, odour, and when fairly pure it is said to resemble cocoa butter.

Amongst other important economic plants or drugs mentioned are the Coca (*Erythroxylon coca*), the medical effects of which have attracted so much attention of late; the Jamaica Chewstick (*Gouania domingensis*), which, it is stated, "has recently been introduced into this country by one of our leading London dentists for use in tooth powder and mouth wash," and also in the form of a fluid extract as a gargle for relaxed throat.

Of Papaine, the active principle of the Papaw (*Carica papaya*), some interesting records are given regarding its effects in treatment of diphtheria, croup, indigestion, dyspepsia, &c.

## 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. No notice is taken of anonymous communications.*

*[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]*

### Ocular After Images and Lightning

In reply to Mr. [illegible] Thibwell's question whether the pictures of the lightning flash [illegible] purely subjective phenomena [illegible], I send the following extract from my notebook, [illegible], 1879: "[illegible] lightning [illegible] flashes all [illegible] within a fraction of a second of each other. There was a [illegible] thunder [illegible] at night, the thunder almost [illegible]. Drawing the curtain [illegible] the window so as to expose only a narrow slit of daylight, I [illegible] the [illegible] glass which I kept moving rapidly backwards and forwards [illegible]. Whenever a flash occurred, several images of the slit appeared, showing that [illegible] illuminations of the slit."

This was not the result I had expected, the experiment having been suggested by my mind [illegible] experiments I had been making on the phenomena of recurrent vision. The results of [illegible] experiments were published in the *Phil. Mag.*, December supplement 1872. [illegible] experiments was to [illegible] in what way the colour of the recurrent image depends upon the colour of the light producing it. By using a sliding shutter and a small window covered with different coloured glasses, I found that the colour of the recurrent image tends to be that of the complementary to that of the light causing it, being, however, in all cases lighter than the complementary tint. I add the following extract from my paper: "A recurrent image of an object may be produced without any apparatus whatever. To do this, place the right hand over the eyes so that the palm of the hand covers the right eye, and the fingers the left eye. If the middle finger be then raised for a moment, so as to admit light for as short a time as possible into the eye, a recurrent image of any light coloured object held against a dark background may be seen. The effect is much better seen by twilight or gaslight than in full daylight. This method of producing a recurrent image is, however, much inferior to that in which a sliding shutter is used, owing probably to the illumination of the object not being sufficiently instantaneous."

Cheltenham College, June 6 A. S. Davis

### A Quinquefoliate Strawberry

In your issue for April 30 (vol. xxxi. p. [illegible]) is an account of a quinquefoliate strawberry. In the garden of the New York Agricultural Experiment Station at Geneva we have some second-year seedling strawberries, some of which are bearing three, four, and five leaflets on the same plant, the leaves all large and perfect. We have other plants in which the two extra leaves are borne half way down the petiole, and which attain fair size, and yet others where these stipulary like appendages are reduced to harmless [illegible]. The variety of strawberry introduced under the name "Mrs. [illegible]" frequently has these bract-like appendages. While speaking of the strawberry, I would remark that seedling strawberries very frequently are unifoliate during their early growth, and it appears as if Duchesne's *Fragaria monophylla* may be regarded as an instance of arrested development in one of the [illegible] forms.

E. Lewis Sturtevant

New York Agricultural Experiment Station, Geneva, N.Y., May 25

## OBSERVATIONS OF THE TEMPERATURE OF THE SEA AND AIR, MADE DURING A VOYAGE FROM ENGLAND TO THE RIVER PLATE IN THE S.S. "LEIBNITZ"

Being obliged to proceed to South America at the beginning of this year, I took with me a thermometer and a hydrometer in order, if circumstances were favourable, to provide myself with occupation during the somewhat long and monotonous voyage. Thanks to the kindness and courtesy of Capt. Brown, of the s.s. *Leibnitz*, who took a lively interest, and assisted me greatly in carrying out my observations, the voyage was neither long nor tedious.

The *Leibnitz* sailed from Southampton on January 16, 1885, and made the passage direct, without touching at intermediate ports, to Monte Video, where she arrived on February 8, after a very favourable voyage. The route lay through the most interesting meteorological districts of the Atlantic, and my principal object at starting was to make as many observations of the temperature and the density of the surface water along the route as possible. With these I combined observations of the temperature of the air, and frequently also of the wet bulb thermometer. Observations were begun on January 21 in lat. 32 N., and continued up to the morning of arrival in the River Plate.

I have [illegible] to collect the simultaneous observations of the temperature of the air and the water with those of the wet bulb thermometer, as they possess some interest of their own; the observations of density are kept for a future opportunity, as the [illegible] in connection with them are not yet finished.

The *thermometer* used for all the observations was divided into single degrees of the Centigrade scale, and was of the ordinary form of German manufacture, with a paper scale. The degrees were 1.6 mm. apart, so that there was no difficulty in estimating tenths of a degree. Its zero was verified on board by immersing it in pounded ice, and found correct. The ice was well pounded in a clean towel, and a soda-water tumbler filled with it; the thermometer was then thrust into it and allowed to remain till sufficient ice had melted to fill up the interstices, producing a perfect magma of ice and water, doing for the cury remained constant on the tem[illegible] ture of the air was 25° C.[1]

*the Water.*—The water was collected [illegible]ell clear of the side of the ship, and [illegible]e from that through which the con[illegible]e engine is discharged. Its tempera[illegible] as soon as the sample was brought [illegible]

[illegible]e Channel in the middle of winter, [illegible]y due south, the temperature of the [illegible] first. Observations were begun in [illegible] N., and between this latitude and [illegible] of rise was very steady, averaging [illegible] latitude. From lat. 5° N. to 15° S. [illegible] very uniform and high, averaging [illegible]ing lat. 15° S. the temperature falls, [illegible]eater variations, as the shallow water [illegible] is approached. The average tem[illegible] over this bank was 25·50° C. After [illegible]d between the parallels of 2[illegible] and [illegible] the variations of temperature are [illegible] abrupt; the maximum observed [illegible], and the minimum 24·3° C. As [illegible]e generally accompanies a greater [illegible] that these variations are due, not [illegible] that these variations, but to an [illegible]e, such as large rivers, but to an [illegible] salt and colder water of the deeper [illegible] own up against the coast, and un[illegible] own up against the surface water. [illegible] hot and dense surface water. [illegible] of the River Plate [illegible] rapid fall of temperature [illegible] [illegible]

[illegible]

ence between any neighbouring maximum and minimum in this region was only 1·1° C.

The maximum temperature of the sea-surface observed during the voyage was 27·4° C. [illegible] at 2 p.m. on January 31, in lat. [illegible] 35′ S., the Brazilian coast being about 100 miles distant. The temperature of the water will be further considered in connection with its density; at present its connection with the temperature of the air will be more particularly considered.

*Temperature of the Air.*—Along with the temperature of the water, that of the air during [illegible] was determined. It is probably very rare, in any part of the [illegible], to find the mean temperature of the air agreeing accurately with that of the surface water, and in many places the differences are considerable. In order to be able to compare the temperature of the air with that of the water, it is necessary that both should be determined with equal accuracy. The temperature of the water is easily and accurately determined by agitating the thermometer in a bucket of fresh [illegible]. With the air it is somewhat different. Having only one thermometer with me, I was obliged to use it for all purposes, and I could not hang it up as a thermometer [illegible], even if I had had one, [illegible] on board ship, however, [illegible] quite impossible to fix the thermometer box in such a position as always to secure [illegible] that the [illegible] of the thermometer may be taken as the true temperature of the air. [illegible] on shore and under the most advantageous circumstances, the temperature of the thermometer in the [illegible] of the [illegible] depends on the temperature [illegible] heat of the material of the box [illegible]

[illegible]

sea-water the observations were continued with it. A few comparative observations were made in order to determine the effect of replacing the sea-water by fresh water. On February 2, after a shower, the temperature of the air was 25·0 C. When wet with sea-water the temperature of the thermometer was 23·5 C., and with rain water 23·8 C. Similarly, at noon on the same day, the following temperatures were observed: dry bulb, 26·1 C.; wet bulb (sea), 24·5 C.; wet bulb (rain), 24·2 C. The air, at this time, appeared, to the sensation, to be damper than at any other time, and yet, when suitably exposed, there was a difference of nearly 2° C. between the wet and dry thermometers.

There is an advantage in having the bulb of the thermometer wet with a continuous film of water, instead of being surrounded with damp muslin, namely, that it more nearly resembles the surface of the sea which is exposed to the influence of the atmosphere. Observations with the wet thermometer were not made as regularly as those with the dry instrument, and no observations were made with either of them after dark, owing to the difficulty of securing proper exposure and reading the instrument with a lantern, without heating it.

The temperature of the air and of the water were taken generally every two hours from 6 a.m. to 6 p.m., but the intervals between the observations were not always the same. These observations showed that only on two days, January 31 and February 1, between lat. 6° S. and 12° S., did the mean *dry* temperature of the air exceed that of the surface water. On these days the temperatures were taken every two hours from 6 a.m. to 6 p.m., and the means of the groups of seven observations gave, on January 31: air, 27°·13 C.; sea, 26°·90 C.; difference, 0°·23 C.; and on February 1, air, 27°·[illegible] C.; sea, 26°·[illegible] C.; difference, 0°·37 C. These differences would have been reduced in amount if the observations had been carried on through the night, though, from the very high temperature of the air just before sunrise on February 1 and 2, they would not have been reduced to zero.

In the table (p. 120) all the simultaneous observations of temperature of air and water made during the voyage, except those of the last day, when approaching the mouth of the River Plate, are collected in small tables for each day. The time of day is given in hours, from 1 to 24; the temperatures are in Centigrade degrees; *t* denotes the temperature of the sea-surface, *t* – *T* the difference between that of the temperature of the air, and *t* – *t'* the difference between the readings of the thermometer in air with its bulb dry and when it is wet with sea-water. At the head of each table is given the meteorological district of the ocean through which the ship was passing, as "north-east trade winds," "equatorial calms," and the like; also the day of the month (1885) and the latitude and longitude at noon of the day. The means [illegible] of each table are simply the arithmetical means of the numbers in each column, and their meaning and value are at once apparent on inspecting the table.

With the two exceptions above named, the temperature of the sea was always found higher than that of the air, during the day, and only very seldom was it exceeded by that of the air at the hottest time of the day. Had the observations been carried on through the night, the [illegible] between the two temperatures would have been [illegible]. On January 31 and February 1 the conditions were somewhat exceptional. On the forenoon of these days the ship passed into the northerly monsoon, which prevails all down the Brazilian coast during the southern summer. Like the similar monsoons in the northern hemisphere, it is caused by the proximity of a large mass of land, which gets intensely heated by the vertical rays of the sun. On January 30 the wind had been light south-easterly; during the night it fell calm, and at sunrise a light easterly wind sprang up, which gradually drew around towards the north and blew all day, with just sufficient force to travel exactly at the same rate as the ship (11½ knots); consequently during the whole of the day the atmosphere on the deck was motionless, with a very powerful sun beating on it and heating up every thing, so that it was impossible to find any place where the air could be got, coming fresh on board, without having been exposed to the influence of the highly-heated deck and fittings. It is therefore certain that the air-temperatures are somewhat above the water.

It is probable that, when the true temperature of the air can be ascertained, it will be found to be usually below that of the sea-surface. The cause of this is, I think, to be found in the relative dryness of the atmosphere over the ocean. If the observations with the wet-bulb thermometer be considered, it will be seen that the least difference of reading between the dry- and the wet-bulb thermometers was 1·0 C. on January 28, when the ship was in the middle of the equatorial belt of calms and rains. In this region perfectly saturated air might be expected, and with instruments exposed in the usual form of box I have no doubt that here, and in the very oppressive weather of the northerly monsoon, the two instruments would have given identical readings. The readings of the air-temperature on January 28 were perfectly trustworthy, as the sky was thickly overcast with dense rain-clouds all day; there was thus no risk of over-heating; the readings with the wetted bulb were equally satisfactory, so that the results of the observations on that day may be taken to represent fairly the normal state of things in the "Doldrums." The temperature of the sea varied from 26·3 to 26·6 C., the mean of the observations during the day being 26·42 C. The mean temperature of the air during the day was 0·[illegible] lower than that of the sea, or 25·5 C., and the temperature of the wet bulb thermometer 1·3 lower still, or 24·2 C. It will be seen that, on the two exceptional days, January 31 and February 1, the difference between the wet and the dry bulb thermometer is greater than would be expected from the oppressive damp feeling of the air. It is therefore all the more likely that the dry-bulb readings are too high as indicated above. However, it is important to observe that in all the regions passed through, whether in the westerly winds of the North Atlantic, in the equatorial calms, or the monsoons of the South Atlantic, the temperature of the wet-bulb thermometer is always very markedly below that of the dry-bulb thermometer. In fact, such is the aridity of the atmosphere that it rarely has the opportunity of saturating itself; and if the effect which must be produced when this air carries the surface of the water be considered, it will, I think, afford some explanation of why at sea the temperature of the air, even by day, should be usually markedly below that of the sea-surface.

If we consider the film of water immersed at the surface of the sea, between the atmosphere on the one side of it and the bulk of the water on the other, it is strictly comparable with the film of water surrounding the bulb of the thermometer, when exposed to the atmosphere in the way described above; and the air blowing upon it must produce exactly the same effect in the one case as in the other. The evaporation lowers the temperature of the aqueous film, which proceeds to extract heat from the neighbouring bodies, namely, in the one case the air and the bulb of the thermometer, and in the other case the air and the layer of water immediately below the surface film. If we imagine for a moment the surface film separated from the bulk of the water below it by a diaphragm impervious to heat, then exposed to the atmosphere so as to suffer evaporation and lowering of temperature, then on the removal of the diaphragm it would immediately sink away from the surface and its place would be taken by warmer, and therefore less dense, water from below. In the case of sea water this effect would be slightly intensified by the concentration produced by evaporation. But

| Hours | t °C | t−T °C | T−T' °C | Hours | t °C | t−T °C | T−T' °C | Hours | t °C | t−T °C | T−T' °C | Hours | t °C | t−T °C | T−T' °C | Hours | t °C | t−T °C | T−T' °C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8¼ | 15.9 | 2.1 | | 8¼ | 20.5 | 1.5 | | 8¼ | 22.0 | 1.4 | 1.6 | 8 | 25.2 | 1.0 | 3.0 | 6 | 25.4 | 1.5 | |
| 10 | 19.3 | [illegible] | | [illegible] | 20.7 | [illegible] | | 10 | 22.0 | 0.8 | | 10 | 23.8 | 0.8 | — | 8 | 25.0 | 0.9 | 2.7 |
| 12 | 19.2 | [illegible] | | 12 | 20.9 | [illegible] | | 12 | 22.2 | 0.7 | | 12 | 24.0 | 0.7 | 1.8 | 10 | 25.7 | 0.9 | |
| 14 | 19.3 | 0.8 | | 14 | 21.1 | 1.1 | | 14 | 22.2 | [illegible] | | 14 | 24.0 | 0.9 | 2.1 | 13 | [illegible] | 1.0 | 3.0 |
| 16½ | 19.7 | 1.7 | | 16 | 21.2 | 1.2 | | 16 | 22.7 | 1.7 | | 16 | 24.2 | 1.1 | | 16 | 26.0 | 1.0 | |
| 17¾ | 19.9 | 1.0 | | 17½ | 21.2 | 1.3 | | 17¼ | 22.3 | 1.2 | | 17¼ | 24.2 | 1.0 | | 17½ | 26.0 | 1.0 | |
| Mean | 19.33 | 1.38 | | | 20.95 | 1.15 | | | 22.23 | 1.15 | | | 23.90 | 0.92 | | | 25.74 | 1.05 | |

[illegible]

N. [illegible] Monsoon. Jan. 31, Lat. [illegible] S., Long. 3[illegible] W.

Northerly Monsoon. Feb. 1, Lat. 11 18′ S., Long. 34 53′ W.

Mean: 26.91, 0.23, 2.38 | 26.05, 0.30, 2.40

[illegible]

S.E. Trade Wind. Feb. 3, Lat. 27 8′ S., Long. 44 1 W.

S.E. Trade Wind. Feb. 6, Lat. 30 13′ S., Long. 47 52 W.

Mean: 25.41, 0.97, 3.72 | 24.57, 0.85, 2.97

while the water below supplies some of the heat rendered latent by the evaporation of the water, the air above it supplies its share, and is cooled. In both cases the heat thus lost is made good by the direct radiation from the sun. Through a moderately dry atmosphere the rays pass with comparatively little heating effect, but are largely absorbed on entering the water. Consequently the loss of heat which the water suffers by evaporation at the surface of separation is made good more abundantly than that sustained by the air; and the difference in power of absorption of radiant heat exhibited by these two substances is thus sufficient to keep up a permanent difference of temperature between the water and the air immediately above it.

Starting with air and water of the same temperature, we may imagine the process taking place in three acts. First, the water at the surface evaporates, and the air on the one side, and the water on the other, are cooled; second, in order to make up for the heat thus rendered latent and lost, the sun shines upon both alike, but the water absorbs a larger proportion of the heat of its rays than the air does; and finally, a portion of this excess is then removed from the water by the simple contact of the air at its surface. The net effect of these causes is to produce a permanent excess of temperature of the surface-water of the sea over that of the air above it, provided that that air is not completely saturated with moisture.

From what I have seen and experienced in the regions visited by the south-west monsoon in the east, I cannot doubt that there are often cases where the most carefully exposed wet- and dry-bulb thermometers would show identical readings, and the atmosphere is completely saturated with vapour of water. Then it is probable that the temperature of the air would not be inferior to that of the water. Further, when, on the eastern coasts of Asia, the south-west monsoon blows out of the China Sea and penetrates far into the North Pacific, off the coasts of Japan it attains a latitude of naturally lower temperature than that from which it proceeded, so that much of the water with which it was laden, and which it held diffused through it as a mere gas, is condensed and remains suspended in it, producing a visible haze, which obscures the horizon and condenses on all solid objects exposed to it. Here the conditions are reversed, and instead of the air losing heat to evaporate the water, it receives the heat liberated by the condensation of the steam removed from waters of lower latitude. Such conditions are, however, [illegible] and there can be little doubt that, as a rule, the temperature of the surface-water of the sea is higher than that of the air. The temperature of the air depends on that of the water which tends to warm it and the degree of its own dryness, by virtue of which the water has a tendency to evaporate into it and, by extracting heat from it for this purpose, to cool it.

It is obvious that local [illegible] and [illegible] currents may produce differences between the temperature of the air and the water, but such cases are not here under consideration.

J. Y. BUCHANAN

Mendoza, March 18

## THE REV. T. W. WEBB

BY the death of the Rev. Thomas William Webb, M.A., F.R.A.S., English astronomy has lost one of its most assiduous and accomplished votaries. Mr. Webb, who had reached the age of 79 years, passed a long life as the incumbent of two obscure Welsh livings, held by him in succession. At Tretire he may be said to have laid the foundations of those astronomical tastes which took their finished and best-known shape during the later years of his life whilst he was incumbent of Hardwick, in Breconshire. He was a genial and right-thinking parish priest, whose highest aim was the performance of his duty. For the sake of astronomy it was well perhaps that he obtained so little ecclesiastical advancement; for had things been otherwise it is probable that he would never have developed those scientific tastes which have made his name almost a household word. It was my privilege to make his acquaintance upwards of twenty years ago, and I look back with extreme pleasure to the many letters which have passed between us on practical matters connected with observational astronomy and the use of instruments. Whilst Mr. Webb in [illegible] years used to write a good deal in the current scientific magazines of the day, especially the *Intellectual Observer* and the *Student*, it was by his "Celestial Objects for Common Telescopes" that he became [illegible] known in the astronomical world. This work, published in the year 1859, was designed to be a cheap popular abridgment in a modified form of Admiral Smyth's "Celestial Cycle," which had done right good service in providing English amateurs with information as to what to look for and how to find. By 1859 Smyth's work had become both out of print and somewhat out of date, and Mr. Webb's unpretending abridgment filled at once an undoubted void. It is indeed not wholly correct to speak of Webb's "Celestial Objects" as an abridgment of Smyth's older, larger, and more expensive volume. It was this, but it was also a good deal more, for whilst it offered to the possessors of small telescopes convenient lists of objects deserving of their attention, it also supplied an enormous amount of original information connected with the sun, moon, and planets, and the use of telescopes. This information, though no doubt suggested by Admiral Smyth's style, was no mere *réchauffé* of other people's work, but represented the personal experience of an industrious, painstaking, and persevering man working under great difficulties through lack of instrumental means.

I shall never forget the feeling of blank astonishment which crept over my mind one day when, in, I think, the year 1864, Mr. Webb told me that the first edition of his book, and all his magazine articles up to that date describing double stars and clusters, were founded on studies pursued by means of a telescope set up in his garden and not equatorially mounted. This, I well remember, was not said in any spirit of boasting in the garb of mock modesty, but was the casual utterance of a simple truth disclosed without effort or intention. I do not think I ever came in the way of any student of nature of whom it could be so truly said that he was "without guile."

Mr. Webb was every inch a gentleman, and a philosopher in the highest sense of the word. Every line that he wrote contained either the record of some fact noticed by himself, or a sensible deduction from some other facts. When his facts had come to an end he ceased to press on paper, and the result was that no one ever read a sentence of his without learning something useful, set forth in the fewest possible words, often, indeed, in a form of [illegible] which erred on the side of [illegible]; but in these days of penny-a-lining it must often be admitted that there is even such a thing as science penny-a-lining. Mr. Webb's habitual terseness cannot be described as a vice. His private letters show that, where necessary for the instruction of a young astronomer, he never grudged time and trouble for going into details. The highest praise that can be awarded him is that he not only did many useful things himself, but that he set an example of patient and industrious research which resulted in many young men all over the British Empire seeking to imitate his cheery and sensible style of work and thought.

G. F. CHAMBERS

## RESERVATION OF NIAGARA[1]

even years ago Lord Dufferin, then governor of Canada, suggested to Gov. Robinson that the governments of the province of the state of New York should purchase such Niagara Falls as would be required to give the principal points of view, and serve to reserve the natural scenery of the great securing to visitors freedom from those yances which now abound. Subsequently eneral called the attention of the govern to the matter, and recommended the state of New York in accomplishing

nuary, 1879, Gov. Robinson, in his annual message to the legislature of New York, presented this matter, and recommended the appointment of a commission to investigate the question, to confer with the Canadian authorities, to consider what measures were necessary, and to report the results to a succeeding legislature.

By resolution the commissioners of the State Survey were charged with the investigation. This commission included some of the most distinguished men of the state, Ex-Gov. Horatio Seymour, Vice-President of the United States, W. A. Wheeler, Lieut.-Gov. Dorsheimer, President Barnard of Columbia College, and others.

With breadth of view worthy of such men, they state in their report that "under this resolution, it became the duty of the commissioners to ascertain how far the private holding of land about Niagara Falls has worked to public


ough defacements of the scenery ... tency to greater injury ... r the proposed action ... the process of destruction ... ts natural character ... commissioners instructed Mr. ... r of the State Survey to make a ... es, and prepare for this work Mr. Frederick assisted in this work by ... distinguished landscape architect ... on showed that the framework of the ... which forms the ... unsightly structures ... gressing ... beautiful woods that once place of the fine piece of ... lds; the fine piece of ... Island was in jeopardy from ...

[1] From *Science*.

and Mr. Olmsted, and recommended to the legislature of 1880 the passage of an Act to provide for acquiring title to the necessary lands by the exercise of the right of eminent domain, leaving it to a future legislature to consummate the purchase by appropriating the amount for the payment of the awards, if the sum should seem a reasonable price for the property. Such an Act passed the Assembly, but was defeated in the Senate, although the movement was supported by petitions signed by the most distinguished men of this and other countries. The report of the State Survey, with its complete descriptions, illustrations, and maps, then became the basis of a systematic effort on the part of a few determined friends of the Falls to educate and arouse public opinion to save the scenery of Niagara. Early in 1883 this movement ripened into the organisation of an association to promote legislation for preserving the scenery of the Falls of Niagara, Mr. Howard Potter of New York being president, and Hon. J. Hampden Robb, chairman of the executive committee.

Through the efforts of this Niagara Falls association an Act was passed, in 1883, providing for a commission, entitled "The Commissioners of the state reservation at Niagara," and giving them power to proceed through the courts to condemn the lands needed. Ex-Lieut.-Gov. William Dorsheimer is the president of this board; and the other members are President Anderson of Rochester University, Hon. J. Hampden Robb, Hon. Sherman S. Rogers, and Andrew H. Green. With some modifications made necessary by changed conditions, they adopted the plan proposed by the State Survey. The lands selected were then surveyed, and their value appraised by a commission of very high character, appointed by the court, the total value of the lands being \$1,433,429.50. The report of the commissioners of the reservation was made to the present legislature, and a Bill to appropriate this sum was introduced. The Niagara Falls association worked in every part of the state to arouse public opinion to the importance of making this appropriation, and the commissioners laboured most earnestly among the legislators and the people. The battle was a hard one against ignorance and narrow-minded selfishness, but the victory is complete. The legislature, by more than a two-thirds majority, has appropriated the \$1,433,429.50, and the governor has approved the Act.

After six years of almost continuous effort on the part of the active friends of this enlightened project, it is secured by a law which declares that the lands are purchased by the state in order that they may be "restored to, and preserved in, a *state of nature*," and that every part of them shall be for ever free of access to all mankind.

## NOTES

We understand that on the receipt by the Science and Art Department from the Foreign Office of a despatch from Her Majesty's Minister at Washington forwarding information concerning the proposed change in the time for beginning the astronomical day, as recommended by the recent International Meridian Conference at Washington, the Lords of the Committee of Council on Education requested the following Committee to advise them as to what steps should be taken in the matter: Prof. J. C. Adams, F.R.S., the Astronomer-Royal, Capt. Sir F. Evans, K.C.B., R.N., the Hydrographer of the Navy, Gen. Strachey, R.E., C.S.I., F.R.S., Dr. Hind, F.R.S., and Col. Donnelly, R.E. In accordance with their recommendations copies of the Report of the Delegates to the International Prime Meridian Conference at Washington, together with the resolutions adopted by that body, have been sent to various departments of the State, and to the following Societies, &c.: Society of Telegraphic Engineers, Royal Astronomical Society, Royal Society, Submarine Telegraph Company, Eastern Telegraph Company (Limited), Eastern and South African Telegra[illegible] Company (Limited), Eastern Extension, Australasia and Chi[illegible] Telegraph Company (Limited), Railway Clearing House. Th[illegible] have been informed that these resolutions of the Prime Meridi[illegible] Conference appear to my Lords of the Committee of Council [illegible] be such as commend themselves for adoption. But before [illegible] forming the American Government to that effect their Lordsh[illegible] would be glad to receive the opinion of the various societies [illegible] the subject.

The annual meeting for the election of Fellows of the Roy[illegible] Society was held at Burlington House on Thursday, June 4, th[illegible] President in the chair. The following were elected:—Maj[illegible] A. W. Baird, R.E., Philip Herbert Carpenter, D.Sc., [illegible] Andrew Clark, Bart., M.D., Andrew Ainslie Commo[illegible] F.R.A.S., Staff-Commander Ettrick William Creak, R.N[illegible] Prof. Edward Divers, Henry Hicks, M.D., William Mitchis[illegible] Hicks, M.A., Francis R. Japp, Ph.D., Arthur Milnes Marsha[illegible] M.D., Prof. Henry Newell Martin, D.Sc., Cornelius O'Sulliva[illegible] Prof. John Perry, Prof. Sydney Ringer, Sidney Howard Vine[illegible] D.Sc.

The Davis lectures upon zoological subjects will be given [illegible] the Lecture Room in the Zoological Society's Gardens, Regen[illegible] Park, on Thursdays, at 5 p.m. The first was given on Thur[illegible] day, June 4, the subject being "Rhinoceroses and their Extin[illegible] Allies," by Prof. Flower, LL.D., V.P.R.S. The others are:[illegible] Thursday, June 11, "Apes and Lemurs," by Dr. St. Geor[illegible] Mivart, F.R.S.; Thursday, June 18, "The Structure of th[illegible] Swan," by Prof. W. K. Parker, F.R.S.; Thursday, June 2[illegible] "The Domestic Cat," by J. E. Harting, F.L.S.; Thursda[illegible] July 2, "Recent Advances in Zoology," by Prof. F. Jeffr[illegible] Bell, M.A.; Thursday, July 9, "The Ancestry of Birds," [illegible] F. E. Beddard, M.A.; Thursday, July 16, "The Animals [illegible] New Guinea," by P. L. Sclater, F.R.S.

In the second edition of his work, "Sur l'Origine du Monde," M. Faye has promulgated the following hypothesis regardin[illegible] the relations between the geological epochs and the stages of th[illegible] terrestrial cosmogony. The history of the earth he divides int[illegible] six stages. The first is that in which the earth was a glowin[illegible] ball. The second he calls the *Initial period*, in which total dark[illegible] ness supervened on the extinction of the earth's glow. The thir[illegible] is the *Primary period*, in which there was a feeble illumina[illegible] tion from the sun, which was then just coming into existence. During the *Secondary period* the sunlight went on increasing a[illegible] the earth [illegible] grew larger and assumed its proper shape. In th[illegible] fifth [illegible] which is that of the *Tertiary period*, there wa[illegible] complete solar illumination, and the sun [illegible] the max[illegible] mum of its [illegible] while in the [illegible], that of th[illegible] *Quaternary period*, there has been a slight diminution of th[illegible] solar activity [illegible], accompanie[illegible] by the disappearance of [illegible] and th[illegible] establishment of [illegible] direction. Oscillations in the [illegible] manifesta[illegible] tions [illegible] change sti[illegible] observable.

We have received from MM. Fol et Sarasin a copy of a pape[illegible] by them on the depth to which the light of the sun will pene[illegible] trate into the sea. It will be remembered that in Novembe[illegible] last they recounted the results of their experiments on the sam[illegible] subject in the Lake of Geneva. The present paper describe[illegible] similar experiments made in the Mediterranean off the zoolog[illegible] cal station and harbour of Villefranche. By means of photo[illegible] graphic plates they have proved that in the month of March, i[illegible] the middle of a sunny day, the rays of the sun do not penetrat[illegible] beyond 400 metres below the surface of the Mediterranean. This is established by seven separate experiments, at varyin[illegible]

…st hours of the morning. At 380 metres, …m., the impression on the plate was less than …ave been left on exposure to the air on a …a moon. Between 1.20 and 1.30 p.m., at a …0 metres, there was no trace of any im… …n the plate. Light clouds do not appear to …iminution in the depth to which the light … Lake of Geneva the writers also undertook …estigations to determine the effect of the …ation of light. They give 200 metres as … winter in the lake; but they found that … at 380 metres in the Mediterranean is as …ake of Geneva; and by a comparison of …xperiments, it appears the light penetrates … deeper in March than in September; in …, perhaps the difference is a little more. … series of plates exposed in the lake, …anean are characterised by a slower and …n. This gives rise to the idea that while … would be promptly intercepted by the …r less disturbed or muddy, in the Mediterra… …roper to pure water would be the principal …n arresting the luminous rays.

…s to *Ausland* on the causes of the And… … Rzehak, of Brunn, maintains that they …the "tectonic" class of terrestrial dis… …se which are connected with the… …re elevated. Evidence of this … …nner in which the di… …lt. The entire area of disturbance in the …s of December last … divisible into three … zone in the south, where the shock … …dalusia proper, which was likewise … …sturbances; and (3) the … …rpetens chain … …as already pointed out by M. … …, the shocks completely … …ed by lines of fault. A great … the northern slopes of the … …r eastwards to the district lying … …s of this line scarcely any place … …quake, except those which, like … …, lie close to … where the degree of shock … fault of the Guadalquivir … the south. A third great … Sierra … …ended.

… has been conferred upon Mr. … General (Retired), Medical Department, … B. N. Hennessey, late Deputy … Department.

… Society of Vienna has … …n on Mount Sonnenblick … …r Tyrolese Alps, … …est station of the kind in … 

…of British Architects … …y Schliemann, … …ging the medal … …istoric architecture … …, Homer, whose … …rangement of the heroic … 

…port of the earthquake in … …occasioned in the north-western …

of the valley. The ground opened, and the villages of Bulgaon, Jamalapur, and … were swallowed up, while sulphurous dust and hot water issued from the cracks. The fort at … and the … stone-houses were burned. A telegram sent from Srinagar on Friday last says:—"The shocks continue every three hours, with much preliminary noise, but a comparatively slight motion. The great shock appears to have travelled in a southerly direction, and to have been felt at several places in Northern India, although it did no damage there."

The death is announced, at the age of fifty-two, of Robert von Schlagintweit, Professor of Geography and Ethnology at the University of Giessen. He was the youngest of the three brothers Schlagintweit who, on the recommendation of Alexander von Humboldt, and under the protection of Lieut.-Col. Sykes, were sent by the British East India Company to explore that country, and … regions in the north-west. The results of … which lasted for several years, … comprehensive works of the highest scientific value.

Interesting experiments in aerial navigation are now being … by Mr. … Gower, well known in connection with the Gower-Bell telephone. …

[illegible]

hundred persons are reported to have perished, and it is feared that the loss of life will prove even greater.

A WATERSPOUT passed over a portion of the town of Hagenau (Alsace) on May 23 last, doing very great damage to houses and trees.

At Stendal (Prussian Saxony) a Committee for the erection of a monument [illegible] memory of Dr. Gustav Nachtigal has been formed, and contributions towards this object are solicited.

THE Austrian Central Tourist Club has addressed a petition to the Assemblies of all Austrian alpine provinces to pass a law prohibiting the wholesale uprooting of Edelweiss now carried on. The petitioners point out that hundreds of thousands of the plants are dug up and sent abroad, even to America, so that there is a fear that the favourite plant of all lovers of the Alps will be totally exterminated, except in a few remote places. In Switzerland, it is stated, for several years past there have been stringent laws in the several cantons against uprooting and selling the Edelweiss.

THE effect of wind in fertilising the ground is remarkably illustrated, according to M. Alluard, by the very fertile valley of Limagne, in Auvergne. The prevalent winds there are west and south-west, and traverse the chain of the Dômes, where are vast deposits of volcanic ashes. Much of this dust is thus carried to the Limagne valley, and settles there of itself, or is carried down by rain or snow. As it contains a large amount of phosphoric acid, potash, and lime, it is highly fertilising, and its very fine state favours rapid assimilation. From observations on the Puy de Dôme, M. Alluard estimates the annual deposit at 345 to 400 grammes per square metre.

WE have received the Calendar of the University of Virginia for the academical year 1884-85. The science department appears to be exceptionally strong and well organised.

ONE result of the recent visit of the Ameer of Afghanistan to India is that his palace at Cabul is to be lit by the electric light. He ordered the necessary apparatus when at Rawul Pindi, and three Cabulese have for some time past been studying its manipulation at Bombay.

WE have received a copy of a lecture by Mr. Thomas Fletcher, delivered before the Parkes Museum of Hygiene, on "Smokeless Homes and Manufactories." It deals mainly with the lecturer's personal experiences of the employment of gaseous fuel in the private residence and manufactory at Warrington, the appliances which he has used, a comparison of the cost with ordinary fuel, the work done, &c. In reply to a question, Mr. Fletcher expressed the opinion that radiant heat is the only possible comfortable way of heating a living room, and that it is therefore better to use gas with [illegible] to prevent smoke, and heat as large a surface as possible to a moderate extent.

ACCORDING to a report by the Director of Public Instruction in Tunis, there are at the present moment twenty primary schools in the Regency—eight in Tunis, and twelve in other towns—Sfax, Monastir, Sousse, Goletta, &c. In this number are included those in one of the Islands—Djerba—at Sousse, Gabes, and Mehdia. The number of pupils is 3924, composed of 2241 boys and 1683 girls. The report notes that there is in addition a certain number of primary schools in which the instruction is religious. Of these there are 113 in Tunis and about 900 in the whole Regency. For secondary instruction there are three establishments, all in Tunis. These contain 23 classes with 38 masters, giving instruction to 416 pupils, of whom 78 are French, 27 Italian, 26 Anglo-Maltese, 74 Jews, 193 Arabs, and 18 of various nationalities.

A MEETING of the National Fish Culture Association was held on Thursday last to consider the question of instituting sea temperature observations with a view to gaining independent and fresh knowledge with respect to our marine food-fishes. The subject of marine stations was discussed together with other matters relative to log books to be issued to suitable investigators.

THE additions to the Zoological Society's Gardens during the past week include a Squirrel Monkey (Chrysothrix sciurea) from Demerara, presented by Mr. T. C. Edwards-Moss; a Common Badger (Meles taxus) from Derbyshire, presented by His Grace the Duke of Devonshire, K.G., F.Z.S.; a Common Badger (Meles taxus) from North Wales, presented by Mr. T. W. [illegible]; two Common Hedgehogs (Erinaceus europaeus), a Common Viper (Vipera berus) from Norfolk, presented by Mr. J. E. [illegible]; a Chattering Lory (Lorius garrulus) from Moluccas, presented by Mr. H. H. Astley, F.Z.S.; a Red-crested Cardinal (Paroaria cucullata) from South America, presented by Mrs. Hyman; a White-tailed Eagle (Haliaetus albicilla) from Perthshire, presented by Mr. H. Tennent Tennent; a Manx Shearwater (Puffinus anglorum), a Puffin (Fratercula arctica), British, presented by Mr. W. Gorham, F.Z.S.; an Egyptian Monitor (Varanus niloticus) from West Africa, presented by Mr. H. Danby; an African Lepidosiren (Protopterus annectens) from African Rivers, presented by Mr. Cornelius Alfred Maloney, C.M.G.; two Slowworms (Anguis fragilis), British, presented by Mr. E. J. Guy; a Sharp-nosed Crocodile (Crocodilus acutus) from Jamaica, deposited; a Collared Fruit Bat (Cynonycteris collaris), an Axis Deer (Cervus axis ♀), a Hybrid Barbary Deer between Cervus barbarus and Cervus [illegible] ♂, a Barbary Wild Sheep (Ovis tragelaphus), two Triangular-spotted Pigeons (Columba guinea), a Variegated Sheldrake (Tadorna variegata), a Herring Gull (Larus argentatus), twenty Spotted Salamanders (Salamandra maculosa), thirty Pleurodele Newts (Molge waltli), bred in the Gardens.

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, JUNE 14-20

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on June 14*

Sun rises, 3h. 43m.; souths, 11h. 59m. 50·0s.; sets, 20h. 16m.; decl. on meridian, 23° 18′ N.; Sidereal Time at Sunset, 13h. 49m.

Moon (at First Quarter on June 19, 14h.) rises, 5h. 46m.; souths 13h. [illegible]; sets, 21h. 25m.; decl. on meridian, 17° 37′ N.

| Planet | Rises | Souths | Sets | Decl. on meridian |
|---|---|---|---|---|
| | h. m. | h. m. | h. m. | ° ′ |
| Mercury | 2 58 | 10 50 | 18 51 | 20 45 N. |
| Venus | 4 20 | 12 48 | 21 10 | 24 11 N. |
| Mars | 2 18 | 10 7 | 17 50 | 19 17 N. |
| Jupiter | 9 25 | 16 37 | 23 46 | 12 32 N. |
| Saturn | 4 2 | 12 16 | 20 25 | 22 28 N. |

*Phenomena of Jupiter's Satellites*

| June | h. m. | | June | h. m. | |
|---|---|---|---|---|---|
| 14 | 20 15 | III. tr. egr. | 18 | 23 17 | II. occ. disap. |
| | 22 37 | I. occ. reap. | 20 | 20 33 | II. tr. egr. |
| 16 | 22 24 | IV. tr. ing. | | | |

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

| June | h. | |
|---|---|---|
| 17 | 23 | Jupiter in conjunction with and 3° 44′ north of the Moon. |
| 18 | 23 | Saturn in conjunction with the Sun. |

## GEOGRAPHICAL NOTES

AFTER having lost, in December last, their director, Prof. W. [illegible], and in January one of their most active members, W. A. [illegible], the Russian Geological Commission has again sustained a heavy loss in the death of the distinguished G. P. Helmersen. According to the notice in the last issue of the Izvestia of the Commission he began his scientific career more than sixty years ago at the Dorpat University, and when of age. Throughout his life ... exploring nearly all the surface ... to the Crimea and ... into the Kirghiz Steppes in ... e. The results of his ... monographs, some of which ... of importance, the ... ed in 1831, ... was followed by a ... paper on the ...

[illegible]

## ANNIVERSARY OF THE ROYAL GEOGRAPHICAL SOCIETY

THE Anniversary Meeting of the Royal Geographical Society was held in the theatre of London University on Thursday, the Right Hon. Lord Aberdare, F.R.S., President, in the chair. In his address, Lord Aberdare referred to Mr. Keltie's report on the position of geographical education in England and on the Continent. The Report, Lord Aberdare stated, contains statements and recommendations of the highest interest and importance. Of the state of geographical education in Great Britain Mr. Keltie draws a very dismal picture. "There is no encouragement to give the subject a prominent place in the school curriculum; no provision, except at elementary normal schools, for the training of teachers in the facts and principles of the subject, and in the best methods of teaching it; no inducement to publishers to produce maps, globes, pictures, reliefs, or other apparatus of the quality and in the variety to be found on the Continent; while our ordinary text-books are, as a rule, unskilful compilations by men who have no special knowledge of their subject." This neglect is attributed to the "exigencies of examination." Geography, as a class-subject, "does not pay." It is not recognised at the Universities by either professorship or readership; it does not find a real place at any of their examinations; while in the Army and Navy examinations it is at a discount; and such geography as is given is of a very partial character, and is merely left to crammers. These unsatisfactory statements are justified by a large amount of evidence. In striking contrast to this picture is that which Mr. Keltie presents of the state of geographical education in Germany, France, Italy, Switzerland, and several other countries of Europe. Germany, as might be expected, takes the lead, and does its work most thoroughly. But the systematic study of geography is even there of recent creation. It prevails in twelve out of the twenty-one universities of Germany; and nearly all the twelve existing professorships of geography have been founded within the last twelve years. "The ideal aimed at, and being rapidly carried out, is to have one continuous course of geographical instruction from the youngest school-year up to the university." And Mr. Keltie deals with these ascending courses, showing in detail the teaching from the elementary to the higher schools, and in the universities. His examples of lessons he himself heard at some of these schools are most graphic, and suggest their high value in any course of intelligent education.

Lord Aberdare then briefly referred to the conclusions at which Mr. Keltie arrives. These, he stated, are clear, sensible, practical, but by no means encouraging. In all these European countries the curriculum is defined and imposed by the State, which, keeping the purse-strings, dictates the course of instruction. Except over our elementary schools, the State in this country exercises no such power, direct or indirect. We must be content to bring the force of public opinion to bear upon our schools and universities; for with them, and especially with our universities, rests the solution of this great question. Mr. Keltie's Report will be duly considered by the Council; it will doubtless be published; and means, Lord Aberdare ventured to prophesy, will be taken to bring home to our educational authorities, with fresh power and urgency, the necessity for not allowing Great Britain to lag behind our political and commercial rivals, our rivals in human culture, in the systematic study of geography. In the meantime, during the course of the autumn, an exhibition will be formed of the results of Mr. Keltie's labours in collecting specimens of the best text-books, maps, globes, diagrams, models, and other apparatus used in teaching the various branches of geography. This done, it remains for me, Lord Aberdare said, only to express the fervent hope that this latest effort of the Society to promote the studies which it was founded to extend, may meet with a large measure of success and tend to lay the basis of a sound and thoroughly national system of instruction in geography in all its branches, physical, political, and historical.

Lord Aberdare then gave a brief *résumé* of exploring work since his address in November last. He specially referred to the four years' explorations in Eastern Tibet of the Pundit Krishna, and to the geographical work done in connection with the Afghan Boundary Commission.

The preliminary map sent home by Major Holdich rectifies in many important points the erroneous topography in all pre-existing maps, and gives us a clear idea of the surface-configuration and physical condition of one of the most interesting districts in Central Asia.

Further east the indefatigable Colonel Prjevalsky has been recently again heard of from the centre of the continent, at Lob Nor.

In and around the Zhob valley, areas of about 5500 square miles of reconnaissance on the ¼-inch scale, and of 400 square miles of topography in the ½-inch scale are reported to have been completed; thus going far to fill in a reproachful hiatus in our present maps of Afghanistan. The ascent of certain peaks in the Himalaya by a member of the Alpine Club, Mr. W. W. Graham, an account of which was read by him at one of the Society's meetings in June last, has attracted considerable attention in India. The classical lands of Asia Minor have again this year been the subject of topographical investigation. In the winter of 1882-3 a fund was raised by public subscription in order to effect explorations that might throw light on the antiquities and early history of the region. Mr. W. M. Ramsay was entrusted with the execution of this scheme, and travelled with this view, May to October, 1883. He invited a scholar of the American School of Athens, Mr. J. R. S. Sterrett, to accompany him during great part of the summer. During that year's work the conviction grew up that no adequate study of the history of Asia Minor was possible till the ancient topography was better known and that no advance in the study of the ancient topography could be made till a better map of the country had been compiled. It was therefore found necessary, week by week, to pay a growing attention to the natural features of the country, the natural routes of communication, and the natural boundaries separating district from district. Lord Aberdare referred to the work done in New Guinea by Mr. Van Braam Morris, Dutch Resident at Tidore, who has examined this part of the coast, and ascended the Amberno, which had always been reported by passing navigators, on account of its numerous supposed mouths, to be a large river with an extensive delta, and to the journeys into the interior of the Rev. James Chalmers. Mr. Chalmers has visited many parts of this coast along a line of about 500 miles, and penetrated, at various places further inland, by land, than any other European, and his descriptions of the country and the habits of the vivacious, excitable, and pugnacious race of savages with which it is peopled, merit careful attention at the present time. An attempt is about to be made by the experienced traveller Mr. H. O. Forbes to penetrate to the summit of the ranges, or plateaux, which extend along the centre of this part of the great island. Since he left England on this arduous mission some weeks ago we learn that the Sydney and Melbourne branches of the Geographical Society of Australasia have offered to contribute to the expenses of this expedition, which is supported by grants by our Society, the Scottish Geographical Society, and the British Association. In other parts of Australasia the chief additions to our knowledge have been a survey of a large tract of new country in Central Queensland by Mr. C. Winnecke, and the exploration of the King Country in the northern island of New Zealand by Mr. Kerry-Nicholls, of which the explorer himself gave us an account at one of our evening meetings.

In Africa Lord Aberdare referred to the work done by Mr. H. H. Johnston at Kilimanjaro. Since then the brothers Denhardt, who had previously done excellent work in surveying the course of the River Dana, which flows from the southern slopes of Mount Kenia, have left again for East Africa. They have been commissioned, as we are informed by the German African Society, to take up a line of exploration similar to that adopted with so much success by Mr. Joseph Thomson, but to follow it much further to the north than the point reached by our English traveller, namely, to the reported great lake Samburu, north of Lake Bahringo. Further north still the year has witnessed the accomplishment of what may be termed one of the most interesting and difficult feats of all recent African travel. This is the journey of Messrs. F. L. and W. D. James, the authors of the well-known book on the "Wild Tribes of the Soudan," who with three English companions, Messrs. G. P. V. Aylmer, E. Lort Phillips, and J. Godfrey Thrupp, organised an expedition and started last December to cross the north-eastern angle of Africa from Berbera to Mogadoxo. The hostile disposition and uncertain temper of the Somali tribes who inhabit this wide region have hitherto offered invincible obstacles to its exploration by Europeans. Mr. James and his party, however, succeeded in penetrating 400 miles to the south, as far as Barri on the River Webbe, a point about 215 miles distant from Mogadoxo. The interior was found to be a plateau of an average elevation of about 4000 feet.

With regard to the more southerly parts of Eastern Africa, and more especially the region between the Mozambique coast and Lake Nyassa, our knowledge has lately increased by leaps and bounds. The increase has been principally due to the systematic explorations of Mr. Consul O'Neill. The general remark may be permitted that, thanks chiefly to Mr. O'Neill, we now have for the first time a fairly satisfactory knowledge of a region varied in its physical configuration, well watered, and fertile, which has hitherto remained a blank on our maps, notwithstanding the occupation of the coast by the Portuguese for nearly four centuries.

M. Giraud has returned this spring from his exploration of Lake Bangweolo and its outlet, and his unsuccessful attempt to cross Africa by way of the Upper-Congo; Mr. Arnot has crossed from Natal to the Bihé plateau by way of the Upper Zambesi; Mr. Montagu Kerr has crossed Matabele-land and the Zambesi, and penetrated by a new route to the south-western shore of Lake Nyassa; and Mr. Richards has reached from Inhambane the southern districts of Umzila's kingdom. In Western Africa further additons have been made to our knowledge of the Congo, chiefly by the publication of Mr. Stanley's long-expected book and the maps which accompany it, and by Messrs. Grenfell and Comber's careful survey of the middle course of the Congo and the Bochini tributary to the junction of the great river Kwango.

The members of the French Expedition on the Ogowé and the northern tributaries of the Congo have also been doing good work in the survey of the territories newly acquired by France.

In South America a striking feat of exploration has been accomplished since my last address; the supposed inaccessible summit of Mount Roraima, on the confines of British Guiana and Brazil, was reached in December last by Mr. im Thurn and his companion, Mr. Perkins, accompanied by a small party of Indians.

In conclusion Lord Aberdare gave the following brief summary of the Admiralty surveys of the year 1884, for which he was indebted to the hydrographer, Capt. Wharton, R.N.: The continuous prosecutions of marine surveys in different quarters of the globe has been well maintained during the past year. The two home-surveying vessels have been employed, one on the west and the other on the east coast of Great Britain. On foreign surveys 60 officers and 500 men have been employed in four steam ships of war and five other smaller vessels. These ships have been at work in Newfoundland, the Bahama Islands, Magellan Straits, South Africa, Red Sea, Malay Peninsula, coasts of China and Korea, north-west coast of Australia, and amongst the Pacific islands. The most important additions to our hydrographical knowledge are as follows:—The survey of the Little Bahama Bank will be shortly finished, and the same may be said of the southern shore of Newfoundland. The survey of the main strait of Magellan, to which reference was made in the last address, was completed early in the year. Many useful additions have been made to ports and salient parts of the coast of south-east Africa. In the Red Sea the intricate approaches to Sawakin have been well laid down. On the west coast of the Malay Peninsula, Penang harbour has been re-surveyed and the positions of the islands lying to the north-west and forming the eastern boundary of the ordinary route of vessels to Malacca Strait have been accurately determined. The unknown western shores of Korea, south of the approach to Seoul, for two degrees of latitude have been explored, and the main features of this island-studded shore laid down. New rivers and harbours have been entered, notably, the large river Yeun-san-gang, at the entrance to which stands the considerable town of Mokfo. There appears, however, to be little chance of immediate trade with Korea, in consequence of the absence of any valuable products and the scanty needs of the population. The southern approach to Haitan Strait on the Chinese coast, much used by British trade, has been re-charted. On the difficult shores of Western Australia such progress has been made as the small means at the disposal of the surveyors has permitted. In the Solomon Islands the Bougainville Strait has been charted. This Channel will in the future be most probably a highway for traffic between Eastern Australia and Japan. Many additions have been also made to the charts of various groups of other Pacific islands. The survey of the coasts of India carried on by officers of the Royal Navy and India Marine has been actively progressing. Surveys of Rangoon, Cheduba, and other ports in the Bay of Bengal, as well as harbours on the west coast of Hindostan, have been made. A re-survey of the great Canadian lakes has been commenced in Georgian Bay, where trade by water is on the increase.

Lord Aberdare then intimated his resignation of the Presidency of the Society, the Marquis of Lorne having been elected to succeed him.

## *PROF. REYNOLDS ON THE STEAM INDICATOR*[1]

THE object of this paper was to define the causes and extent of the disturbances in indicator diagrams. The theory, as given, had been taught for several years in Owens College; but the publication had been deferred to enable an extensive series of experiments to be made. These experiments had now been carried out by Mr. A. W. Brightmore, Stud. Inst. C.E., late Berkeley Fellow in Owens College. In the first place it was shown that there were five principal causes of disturbance, namely: the inertia of the piston of the indicator and its attached weights; the friction of the pencil on the paper, and its attached mechanism; varying action of the spring; inertia of the drum; friction of the drum.

The effect of the inertia of the pencil and its attached mechanism presented a mathematical problem, by the solution of which it was shown that there were two disturbances from this cause: one, a general enlargement of the mean indicated pressure, depending on the weight of the moving parts of the indicator, the stiffness of the spring, and the square of the speed. The other disturbance was a vibration of the pencil. Every indicator piston vibrated when disturbed, so that the period of vibration depended on the stiffness of the spring.

The error which these oscillations caused in the area of the diagram depended on their magnitude, and, to a greater extent, on the smallness of the number in a revolution. But the evil of these oscillations was not so much an effect on the area as in the disfigurement and the confusion they produced in the diagram. So long as there were thirty of these oscillations in a cycle, the necessary fluid friction of the indicator piston would so far reduce them as to render a fair diagram possible, but when the number was as low as ten it was all the pencil could do to prevent them upsetting the diagram.

The friction arising from the pressure of the pencil always acted to oppose the motion of the pencil, and therefore rendered it too large during expansion and exhaust and too small during compression and admission, and thus the general effect was to increase the size of the diagram. This friction consisted of that of the pencil on the paper; and that of the mechanism, caused by sustaining the pressure of the pencil. The effect of the friction of the pencil was greatly reduced by the motion of the paper. The magnitude of these effects taken together on the area of the diagram depended on the construction of the instrument and on pencil-pressure. From numerous experiments it would appear possible to make a difference of as much as five per cent. in a locomotive in mid-gear by pencil-friction.

The conclusions, as regarded the motion of the pencil, were that the general effect of inertia and friction were both to increase the size of the diagram; that so long as the speeds were such that the number of vibrations of the pencil during a revolution of the engine was not greater than fifteen, the effect of inertia was less than one per cent., but that, if the number was greater than thirty, oscillations would show themselves unless the pencil-friction was increased. They might, by this, be kept down till the number of vibrations was equal to fifteen, but not farther, and then the necessary friction would affect the area of the diagram about five per cent. For the diagrams to be sensibly accurate, and free from oscillation, the speeds must not be greater than would make the number of vibrations equal to thirty. These speeds were given in the paper for Richards' indicators.

The effect of the inertia of the drum with an elastic cord was shown to be a nearly uniform elongation of the diagram. The result of the varying stiffness of the drum spring was a nearly uniform contraction. With Richards' indicator these two latter disturbances neutralized each other at a speed of 150 revolutions per minute. At other speeds the effects were apparent in the length of the diagram; but, except when the expansion was great and the connecting rod short, they did not affect the indicated pressure. The friction of the drum with an elastic cord caused the cord to be longer during the forward stroke than during the

[1] A Paper read at the Institution of Civil Engineers, May 19, "On the Theory of the Indicator and the Errors in Indicator Diagrams," by Prof. Osborne Reynolds F.R.S.

backward stroke, so that the diagram was distorted and shortened, the drum being uniformly behind its proper position during the forward stroke, and before its position during the backward stroke. [illegible]

reversed so that the front diagram was superimposed on [illegible] back. It was observed that the diagrams were of diffe[rent] lengths, [illegible]

## THE VISITATION OF THE ROYAL OBSERVATORY, GREENWICH

[illegible]

transits of the close circumpolar stars have ... were set to successive revolutions of the ... virtually introducing a system of very ... for the slow-moving stars. It is thus ... of separate observations can be ... a point of special importance ... The equality of successive intervals of the ... was tested last January for each of ... revolutions, and also for every ... revolutions, and the errors of the ... the errors of observation. The ... of the south collimator, the ... been turned through ... The ... circumpolar stars have also been ... the equality of successive ... screw, the results being very ... micrometers also were ... collimator on March ... being measured ... from ... the west in the ... since 1875, the method ... being in ...

... 1884 ... throughout the whole range ...

... from the observations of 1884 ... the assumed ... of the ecliptic ... from the ...

... measured from ... has been ...

Jupiter's satellites, have been observed in the twelve months ending 1885 May 20, and the observations have all been completely reduced to the end of 1884. Comet [illegible] 1884 has been observed on four nights, the Lassell reflector or one of the other equatorials being employed, and some measures of distances and position-angle of double stars, as well as a large number of observations for determining the value of [illegible] of the screw in different parts of the field of view have been made with the Airy double-image micrometer mounted on the Sheepshanks' or Simms' equatorial.

Micrometer measures of some of the satellites of Saturn (including Hyperion) were made on seven nights with the Lassell equatorial.

*Spectroscopic and Photographic Observations.*—The solar prominences have been observed with the half-prism spectroscope on only two days, the photographic reductions having pressed very severely [illegible] during the long continued maximum of sun-spots.

For the determination of motions of stars in the line of sight, 569 measures have been made of the displacement of the F line in the spectra of 47 stars, and 72 measures of the b lines in 14 stars, besides measures of the displacement of the F and b lines in the spectra of the east and west limbs of Jupiter, and of the east and west ansae of the rings of Saturn, and comparisons with lines in the spectrum of the moon, or of the sky, made in the course of each night's observations of star motions, or at the following morning, as a check on the general accuracy of the results [illegible]. The observations of the last twelve months confirm the change in the motion of Sirius, which now appears to be approaching the sun at the rate of about 20 miles a second. As there is great difficulty in the use of a pointer or [illegible] for measuring both the broad dark line in the star's spectrum and the narrow bright comparison line, Mr. Maunder has suggested the use of [illegible] spectroscope on the double-image principle for these observations, and Prof. Pritchard has kindly lent [illegible] spectroscope of the Oxford University Observatory, in order that the suitability of that form of instrument may be tested. The spectroscopic observations of all kinds are completely reduced to the present time.

In the twelve months ending 1885 May 20 photographs of the sun have been taken on 273 days, and of these 441 have been selected for preservation, the series being not so complete as usual, owing partly to the loss of several days during the adjustment of the instrument after the enlargement of the scale, by magnifier, and partly to a failure of the supply of dry plates in July [illegible] Mr. Maunder. [illegible] two days [illegible] the sun's disk was [illegible] spots.

The mean spotted area of the sun was slightly less in 1884 than in 1883 [illegible] greater than in 1882 [illegible] in 1884 [illegible] compared with 1883 [illegible] slight falling off [illegible] compared with 1882. It would [illegible] the maximum [illegible] end of 1883 or beginning of 1884.

For the year 1884 Greenwich photographs [illegible] for measurement on 152 days, and Indian photographs filling up the gaps in the series [illegible] making a total of 311 days out of 366 on which photographs have been measured. In 1883 the total number of days was 342, [illegible] 215 days, [illegible] Indian photographs received from the Solar Physics Committee on 125 days.

*Magnetic Instruments.*—The following are the principal results for magnetic elements for 1884:—

| | |
|---|---|
| Approximate mean westerly declination | 18° 8'. |
| Mean horizontal force | [illegible] (in English units). [illegible] 1·812 (in Metric units). |
| Mean dip | 67° 20' 8" (by 9-inch needles). 67° 29' 32" (by 6-inch needles). 67° 30' 9" (by 3-inch needles). |

In the year 1884 there were only [illegible] days of great magnetic disturbance, but there were also about 20 days of lesser disturbance for which it appeared desirable to publish tracings of the photographic curves. It may be interesting to add the tracings for a few quiet and nearly quiet days in order to exhibit the [illegible] of the ordinary diurnal movement.

Commencing with 1883 the magnetic diurnal inequalities of declination, horizontal force, and vertical force have been treated by the method of harmonic analysis, the [illegible] expressions for these inequalities being obtained for each [illegible] and for the year with arguments expressed in apparent solar [illegible] as well as in mean solar time.

*Meteorological Observations.*—The mean temperature [illegible] year 1884 was 50°·7, being 1°·4 higher than the average [illegible] last 43 years. The highest air temperature in the shade [illegible] 94°·1 on Aug. 11, and the lowest 24°·5 on Nov. 25. [illegible] mean monthly temperature was above the average except [illegible] the months of April, June, Oct., and Nov.

The mean daily motion of the air in 1884 was 286 [illegible] being 3 miles greater than the average of the last 17 years. [illegible] greatest daily motion was 691 miles on Jan. 23, and the lea[st] [illegible] miles on Feb. 8. The only recorded pressure exceeding 20 [illegible] on the square foot in 1884 was 22·7 lbs. on Jan. 23, after [illegible] the connecting chain of the pressure plate broke, as mentioned in the last report. It is probable that greater pressures occ[urred] afterwards on the same day, and also in the gale of Jan. [illegible] which day the chain had not been renewed.

During the year 1884 Osler's anemometer showed an exce[ss of] about 25 revolutions of the vane in the positive direc[tion] N., E., S., W., N., excluding the turnings which are evid[ently] accidental.

The number of hours of bright sunshine recorded by C[ampbell-Stokes] sunshine instrument during 1884 was 1115, which is [illegible] less than the average of the seven preceding [years]. The aggregate number of hours during which the sun [was] above the horizon was 4465, so that the mean proportion [of] sunshine for the year was 0·250, constant sunshine being represented by 1.

The rainfall in 1884 was 18·0 inches, being about 7 in[ches] below the average of the last 43 years.

*Chronometers and Time Signals.*—The number of chro[nometers] now being tested at the Observatory is 151, and of [these] 103 [illegible] pocket chronometers, and [illegible] deck watches [illegible] Navy [illegible] for [illegible] use by [illegible].

[illegible] in the competitive trial of [illegible] were rather above the average of the last ten years, as infer[illegible] [illegible] temper[ature] [illegible] a co[illegible] gradually cle[illegible] [illegible] into use. [illegible] test [illegible]

[illegible] railed on [illegible] not rais[illegible] [illegible] of the wall.

[illegible] by cu[rrent] [illegible] Post Office tel[egraph] [illegible] to the [illegible] any [illegible] the [illegible].

[illegible] signals [illegible] at any [illegible] Wharton [illegible] Devon[port] [illegible] a loc[al] [illegible] Greenwich at 10 a.m., which should [illegible] start [illegible] clock pendulum. [illegible] would then accelerate [illegible] second [illegible] clock pendulum by electro-magnetic action as [illegible] Greenwich mean [illegible] so as to make [illegible] through the middle of its oscillation at the [illegible] time and [illegible] same direction [illegible] pendulum, and thus to create accurate[ly] Greenwich mean time. A return signal to Greenwich sent [illegible]

next hour (11 A.M.) would show that this
...ly corrected, and would be a guarantee
...cy of the time-signal. Preliminary trials
observation of coincidence of vibration of
... made with great certainty, and Messrs.
... now arranging for the mounting of an
... one of the transit of Venus clocks, and
... hourly time-signals.

...Westminster clock have been under 1s. on
...ys of observation, between 1s. and 2s. on
...2s. and 3s. on 10 per cent., between 3s.
... and over 4s. on 4 per cent.

...r the Observatory has lost the valuable
...n, who retired on August 25, after an
...nty six years, which has been throughout
...kable zeal and ability, and has contributed
... credit of the Observatory. Mr. Dunkin
...he post of Chief Assistant by Mr. H. H.
...ty College, Cambridge.

... as follows:

...r the various classes of work carried on
... have been somewhat extended. The
... are more numerous than usual, and
...stigations involving considerable labour
...ith a view to ... their ... A
...scopic determinations of ...
... the long continued ...
...tographic measurements ...
... in any previous year. Extension have
...gnetic and meteorological branch, which
... but which have pressed rather ...

... I wish to invite the attention of the
... that ... in our ...
... stars in the line of sight with the
... the determinations of proper motions

[illegible]

## ...VIVISECTION

[illegible]

"(2) The total number of experiments of all kinds performed during the year was about 441.

"Of these, 14... were done under the restrictions of the licence alone, 78 ... certificates in column 1 ... 115 under certificates in column 2, 76 under ... a total ... certificate in column 4.

"(3) With regard to the ... all the experiments ... column 2, 3, and 4 ... During the whole of the experiment, and ... the provisions of the ...

"With regard to ... columns 2, 3, and 4, which ... with the use of ...

"(4) ... of the 1... experiments performed under certificates in column 2, ... simple inoculation with a ... virus, ... needle was required, and for which the administration of an anaesthetic would only have ... distress to the animal. In these experiments ... would be felt ... attendant ... the ... ordinary ... experiments under these ... for the purpose of ... legal ... on the ... which survived ... only a few minutes ...

[illegible]

reports of all the professors, lecturers, and heads of departments connected with natural science.

Prof. Thomson, Cavendish Professor of Physics, reports that during the Lent term ninety students attended the demonstrations, and there were ten persons doing original work in the laboratory. Lord Rayleigh states that during the last five years about 2500*l*. has been spent on the Cavendish Laboratory in addition to the University expenditure. This has come partly from fees, partly from the apparatus fund raised by subscription [illegible]

The Chemical Laboratory has been [illegible] improvements are scarcely possible until the new laboratory has been completed.

The register of the mineralogical collections is completed. The number of students [illegible] attended Mr. Solly's demonstrations in the Michaelmas term and nineteen in the Lent term.

The department of mechanism has continued to grow rapidly. During the year two new workshops and a new foundry have been [illegible] [illegible]

The classes of practical morphology and [illegible] are now much better accommodated in the new rooms [illegible] [illegible]

Prof. Macalister has utilised the services of seven assistant Demonstrators, in addition to Mr. Hill, whose labour has been [illegible]

right have attended advanced lectures also. Several important additions, such as a gas engine, a centrifugal machine, recording and other apparatus, have been made to the Laboratory, by the aid of a gift of 500*l*. by an anonymous donor. The inadequacy of accommodation, both for practical work and for lecturing, is severely felt.

Dr. Roy has been successful in organising extended practical courses, as well as systematic lectures. The *post-mortem* examinations at Addenbrooke's Hospital have been placed under his superintendence. At present the only laboratory space available is obtained by encroaching on Dr. Foster's already overcrowded rooms.

Prof. Babington reports that the arrangement of the general Herbarium is now complete. The plants have been placed in orders and genera, according to Bentham and Hooker. The arrangement of species has not as yet been attempted. [illegible]

[illegible]

## SOCIETIES AND ACADEMIES

LONDON

**Royal Society**, May [illegible] [illegible] Secondary Batteries, by William Henry Preece, F.R.S.

[illegible]

[illegible] density of the liquid while the cells are [illegible]-charged. M. Preece puts into his battery [illegible] 20 ampere-hours twice a week. Houtly [illegible] M.F. current and density of liquid have [illegible] the condition of his battery at any period [illegible] These measurements have been plotted [illegible] dinates showing volts, amperes, and specific [illegible] hourly observations. When each [illegible] constant, bubbles of gas are freely given [illegible] wasted. The variation of the electro[illegible] strength is clearly due to the [illegible] the cells, which becomes a maximum [illegible] are fully formed. The counter elect[illegible] [illegible]

[illegible]

[illegible] vary [illegible]

[illegible]

under [illegible] from 1,000 to [illegible] at this time of year [illegible] operation, and it will [illegible] a year [illegible] the whole battery. Sixteen cells have been [illegible] the past [illegible] months.

**Chemical Society**, May 21.—Dr. Hugo Müller, F.R.S., President, in the chair.—[illegible]

[illegible]

**Zoological Society** [illegible]

of Coly [illegible] in the Society's Collection. Mr. Beddard, on behalf of himself and Mr. Treves, read a paper on the anatomy of the Sumatran Rhinoceros (*Ceratorhinus sumatrensis*) which had died in the Society's Gardens in January last. A communication was read from Dr. Julius von Haast, F.R.S., C.M.Z.S., on *Megalapteryx* [illegible], an extinct gigantic representative of the *Apteryx*, of which the remains had recently been discovered in New Zealand. [illegible], F.Z.S., read the fourth and fifth parts of his report on the collection of [illegible] during the voyage of the yacht *Marchesa*. The present communication treated of the birds collected at [illegible] and in the Moluccas [illegible]. Mr. J. Bland Sutton, F.Z.S., read a paper on the development and morphology of the human sphenoid bone, in which he attempted to show that the [illegible] of the [illegible] with the [illegible], and that the [illegible] of the human [illegible] are homologous with the [illegible] of the [illegible]. Mr. Edgar A. Smith, F.Z.S., read a report on a collection of shells, chiefly land and fresh water, obtained by Mr. H. B. Guppy, R.N., Surgeon H.M.S. *Lark*, during a recent visit to Solomon Islands.

PARIS

**Academy of Sciences**, June 2.—M. Bouley, President, in the chair.—Human locomotion, stereoscopic images of the trajectories described in space by a point of the body while walking, running, or otherwise moving [illegible] by M. Marey.—Remarks on the "Registre" [illegible] by Henry Victor Regnault, dealing with a great variety of questions in chemistry, physics, thermodynamics, hygrometry, [illegible] presented to the Academy by M. [illegible] [illegible]

[illegible]

CONTENTS

**of Societies**

LONDON

*RSDAY*, Ju... 11.
Bakerian L...—The ...

*IDAY*, June 12.

*RIDAY*, June ...

*ESDAY*, June 17.

*SDAY*, June 18.

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Of Nature trusts the mind which builds for aye."—Wordsworth

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## [illegible]HLI'S "PROTOZOA"

*[illegible] Ordnungen des Thierreichs.* New [illegible] C. F. Winter, 1883-4-5.)

[illegible] work on the lowest division of the [illegible]om which Prof. Bütschli, of Heidel[illegible] for the publishers of the well-known [illegible]treatises originated by the late Prof. [illegible]anced as to enable us to form some [illegible]s and to call for an extended notice [illegible] of Prof. Bütschli's work which have [illegible] during the last two years have now [illegible] to form a large octavo of 600 pages [illegible] whole of the Protozoa have been di[illegible]eption of the Ciliata, the Dinoflagel[illegible] Cilio-flagellata), and the Acinetaria. [illegible] comprise in its scope the Mycetozoa, [illegible] opinion of the present writer, be in[illegible]al kingdom. This is the less to be [illegible]xcellent work on this group has been [illegible] by Dr. Zopf, of Berlin, in the "[illegible] [illegible]wissenschaften," and may be obtained [illegible]blishers, Trewendt, of Breslau. [illegible]zoa are to be considered as animals [illegible] is the opinion of no less an authority [illegible] De Bary, who has done more than [illegible] to elucidate their life-history and [illegible]

[illegible]he Protozoa into classes as follows: [illegible] Sporozoa, the Mastigophora, and [illegible] and the Tentaculifera, though of the [illegible] yet written. [illegible] divided into the sub-classes Rhi[illegible] [illegible]l Radiolaria. [illegible] contains the sub-class [illegible] [illegible] and [illegible] [illegible] are grouped in sub-classes [illegible] [illegible], Cystoflagellata, and [illegible] [illegible]flagellata). [illegible] classes is treated of in [illegible] [illegible] and comprehensive manner [illegible] [illegible] "Thierreich" know [illegible] [illegible]. The treatment [illegible] [illegible] Review of the Development [illegible] [illegible] sub-class, which [illegible] [illegible]places, but a [illegible] [illegible] contributed by [illegible] [illegible] up of our present [illegible] [illegible] followed by [illegible] [illegible] papers relating to the [illegible] [illegible] literature. We have [illegible] [illegible] completeness of these lists [illegible] [illegible] papers [illegible] [illegible] [illegible] of real importance have been [illegible] [illegible] by Prof. Bütschli [illegible] [illegible] "Short Survey of the Morphology [illegible] [illegible] class and its Chief [illegible] [illegible] prominent morphological [illegible] [illegible] variations in the group [illegible]



thoroughly discussed, references being given to the widely scattered writings of the numerous microscopists who have advanced this or that view or added this or that quantum of fact to our knowledge. Thus in the portion of the work relating to the Rhizopoda we find—

(1) The shell-structure of the Rhizopoda. A. Material of the shell: (*a*) chitinous shells, (*b*) calcareous shells; (*c*) shells built up of foreign particles; (*d*) siliceous shells. B. The morphological structure of the Rhizopod shell: (*a*) [illegible] shells; (*b*) monaxonic shells; (*c*) polythalamous shells; (*d*) abnormal shell-formation.

(2) The structure of the soft body of the Rhizopoda—(*a*) general characters of the soft body; (*b*) properties of the protoplasm of the Rhizopod body in general; (*c*) differentiation of the protoplasm into special zones or [illegible]; (*d*) [illegible] of the protoplasm; (*e*) peculiar bodies enclosed in the protoplasm, [illegible], non-contractile [illegible], and peculiar products of metabolism; contractile vacuoles; nuclei; (*f*) pseudopodia, movement and [illegible] of nutriment in the Rhizopoda; (*g*) gelatinous investment of the soft body.

[illegible] Relation of the soft body to the shell and formation of the shell by the soft body.

(4) Reproductive phenomena, [illegible] formation, and [illegible] of the Rhizopoda: [illegible] reproduction by simple division or budding; [illegible] formation in connection with the division or budding of the Rhizopoda; [illegible] [illegible] in connection with or without reproduction; [illegible] and conjugation in the Rhizopoda; [illegible] [illegible] of the attempts made to prove the existence of a sexual reproduction in the Rhizopoda.

[illegible] Biological relations of the Rhizopoda: (*a*) habitat; [illegible] dependence on external life-conditions.

[illegible] Taxonomy of the Rhizopoda. [illegible] development [illegible] system of the [illegible] of the Rhizopoda, with [illegible] of the [illegible], [illegible] of genera.

[illegible]

[illegible]

[illegible] Rhizopoda [illegible] [illegible] [illegible] [illegible] [illegible] with regard to [illegible]

[illegible] and Heliozoa [illegible] dealt with [illegible]

[illegible] knowledge. In the present work they [illegible] in due place and enable Prof. Bütschli to give a decisive opinion upon many points on which authorities have hitherto differed. Many of the illustrations in the admirably engraved plates are also original.

We may perhaps remind our readers that it is to Prof. Bütschli that we owe the first important paper in the recent development of our knowledge of the karyokinetic figures of dividing cell-nuclei. It is his investigation which demonstrated the identity of the changes in the nuclei of Ciliate Infusoria with the [illegible] fibrillation of normal tissue cells when in course of division, and more than any others have given a wide basis to the recent generalisations on this subject.

Our author is not only extremely fair and scrupulous in citing all discoverable authorities for the facts which he sets forth as to the structure, &c., of Protozoa—our English [illegible] of all ranks will find themselves cited and fairly considered—but he exhibits admirable judgment, temper, and caution in his treatment of several questions. He has wisely withheld his full discussion of the classification of the Radiolaria until such time as Haeckel's Challenger work on the group is published. In the [illegible] of the [illegible] forms of skeleton [illegible] is a masterly essay on a very difficult subject.

With regard to the question of the chlorophyll corpuscles of some Protozoa [illegible] we gather that Prof. Bütschli [illegible] the [illegible] but we shall look for a more definite judgment from him [illegible] when he has [illegible] such forms as the [illegible] *Stentor*, *Bursaria*, and *Ophrydium*.

It is noteworthy that Prof. Bütschli includes the [illegible] Protozoa [illegible] of their relation [illegible] "[illegible]"

It would be impossible here to point out the numerous new views of importance which are [illegible] in Prof. Bütschli's work. It must be sufficient to say that the book is absolutely invaluable [illegible] and is perhaps the most [illegible] yet made [illegible] works of the [illegible] of such.

E. RAY LANKESTER

## PHENOLOGY

*[illegible]*

Von Dr. H. Hoffmann, Professor der Botanik [illegible] Giessen. [illegible]

THIS work, the result of forty years' labour, forms a most important contribution to the literature on the subject of phenology.

The book begins with an introduction, in which is explained the importance of phenological observations, particularly with regard to comparative climatology and biology. Then follows an investigation of the degree of accuracy to be obtained by this kind of observation, succeeded by a discussion as to how many years such observations ought to be continued for obtaining useful and trustworthy information for comparative investigation. A table is then given of those plants and their phases which the author, after forty years' observations, thinks the most proper for adoption with a view to international reception. The number is fifty-three, and they are arranged according to the calendar, to facilitate observation; which system appears with regard to accuracy preferable to an alphabetical arrangement.

A short notice follows of the most important general results of the work with respect to climatology and biology, abstracted from the observations from the whole of Europe. At the end of the introduction the author points out the next tasks for phenological researchers.

The remainder of the book contains an alphabetical list of all phenological stations throughout Europe (about 2000), with the geographical position and elevation above sea-level. [illegible] alphabetical arrangement the [illegible] of the simple phases known from the place, with the number of years of observation.

It is to be seen that from a great number of these but [illegible] have been published, [illegible] above thirty years. These [illegible] place [illegible] as complete as possible, [illegible] the chief [illegible] They are [illegible] published [illegible] works of all [illegible]

[illegible] the author himself has followed the plan of [illegible] each [illegible] the single [illegible] Giessen, the residence of the author, [illegible] generally [illegible] have been [illegible] at the end of the book, the [illegible] entered, [illegible] different [illegible]

## OUR BOOK SHELF

*[illegible]* Son in Law. [illegible] Lady Claud [illegible] 1885.)

[illegible] brilliant [illegible] for some [illegible] that a [illegible] labours [illegible] to [illegible] In this [illegible] a signal [illegible] reaches a [illegible] authentic [illegible] Pasteur's [illegible] and is [illegible] friend [illegible] from [illegible] reader the [illegible] point of [illegible] of many [illegible] not the [illegible] manner, and it gives us a true insight into the working of the

the contemplation of the actual
e book in this sense, we must con-
value to every worker in the same

researches of M. Pasteur—amongst
ed his discoveries that every one
rmentations depends on the growth
te and specific microbe; his long
and final refutation of the doctrine
tion, his immensely practical dis-
rm diseases, on the attenuation of
r and of hydrophobia are described
d their history and progress ren-
l and fascinating manner. Reading
ot know what to admire more in
labours—the way in which a
ed, and solved in all its theoretical
the energy and perseverance with
o yield up her secrets; the fertility
nius, or the ready way in which he
est by direct experiment all objec-
ssible sources of error. His is a
labours grander still!
e congratulated on the admirable
ulfilled her task. Prof. Tyndall's
esting and valuable part of the
E. KLEIN

*ade-Mecum. A Handbook of the ... Anatomy.* By Arthur Bolles
nd A. Churchill, 1885.)

hor tells us that the aim of the
hands of the instructed anatomist
te account of all the methods that
d as useful for the purpose of micro-
also so that it is to serve as a guide
r a perusal of the book we venture
the book will prove useful, it is
less a complete account of all the
ve as a guide to the beginner. A
a collection of formulæ, published
various journals and archives
ted in the *Journal* of the Royal
. The formulæ are more or less
nd without an attempt of intelligible
ormulæ references to the ... authors are
es the references are incomplete
ong, since methods ... by
other. Nor can we see the use of
ninute and sometimes quite ...
of a certain method, as ...

inner, we venture to say that the
up to the expectations of ...
his purpose ought to have done ...
ly methods which he himself ...
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nch of the examination of ...
ed for the application of ...
currents, &c., on fresh and ...
ed in the book; their treatment ...
apparatus used in ... E. KLEIN
useful addition.

## [LETTER]S 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. No notice is taken of anonymous communications.]*

### Prof. Clifford's Kinetic

notice of Clifford's ... NATURE, vol. xxxii. p. 124) ...

so prominently forward the ... in Prof. Pearson's footnotes ... I should somewhat ... the manuscript ... All the ... under Mr. F. ... Mrs. Clifford ... [illegible]

R. TUCKER

University College, London, June 13

### [S]ky Glows

[illegible]

E. K.

### Flying Fish

[illegible]

just enter it. . . . On the second dip the fish went into its partner's mouth, and there was an end of the thing. It always struck me that it seemed a strain on the fish to keep the wings extended.

May 15 ALFRED CARPENTER

## THE UNIVERSAL MERIDIAN[1]

AFTER some preliminary historical matter Dr. Janssen proceeded:—The question as to which of all the meridians encircling the earth ought to serve as the starting line in the general enumeration of the longitudes, is the question known as that of the *prime meridian*, a famous question often taken in hand, never definitively settled, and which the Congress of Washington was charged to decide. Such was at least its intention.

The ancients, who had just ideas in all matters, perfectly understood that a prime meridian ought to be placed at the origin of the lands to be measured. Marinus of Tyre, and after him Ptolemy, chose quite naturally, as the point of departure for their longitudes, the extremity of the world which was best known to them. What was this extremity? It was the islands which navigators encountered beyond the pillars of Hercules in an enchanting climate, where the inhabitants, freed from every toil, lived in peace and happiness on the abundant spontaneous fruits of a prodigal soil, the Fortunate Isles, as they were called, which people pleased themselves with assigning, as a final resting place (Elysian fields) to the souls of heroes.

Homer, Hesiod, Pindar, Plutarch, speak to us of these Fortunate Isles, which were then regarded as the extreme limit of the western dependencies of Africa. Afterwards they were the unknown solitudes of the ocean.

It is from these isles, then, that the great heir of the geography of the Greeks starts his numeration of longitudes. Here again, however, the ignorance of the ancients in the matter of measures did not allow the maintaining of so natural a point of departure. The insufficient knowledge of the position of the Fortunate Isles damaged the whole system, and people later on were compelled to revert to the continent where the measures were less uncertain.

Following Greek science came the middle ages, when the scientific idea disappeared, and was replaced by a religious or political idea. The first line of longitudes was taken anywhere. People took their meridians from capitals, or remarkable places: every one chose his own centre, and the confusion grew to be intolerable. It is noteworthy how it was France which gave the signal for the resuscitation of the scientific idea in this question, and that it is to the great Richelieu we owe it.

It is, however, a false idea of Richelieu's action to consider it as directed by a pure intention of scientific reform, and by the desire alone of serving the general interests. Richelieu is above all a political spirit, and political interests dominate his preoccupations. At the same time, however, he is a [illegible] and [illegible] genius, who feels the necessity of order and serves that necessity by general, great, and elevated measures, for such is the form of his spirit.

What, in fact, was the point of departure of a reform such as science disengaged from all personal interest would alone dictate at the present day? A [illegible] quarrel among maritime nations in reference to a [illegible].

At the commencement of the seventeenth century France made a trial of commerce in distant parts, particularly in the Indies and America.

The navigation and traffic of these countries were then in the hands of the Spanish and Portuguese, who, however little they agreed on the division of these rich spoils among each other, were nevertheless wonderfully united when there was a question of interdicting others from sharing in them. The French ships appearin[g] in the seas either of the East or West Indies were, i[n] point of fact, chased by the Spaniards and the Portuguese. Awaiting the time till he had rendered the French nav[y] strong enough to dispute with these nations a propert[y] which on the whole was the right of all the world, Rich[elieu] [illegible] around France a maritime zone [of] protection. He accordingly negotiated and obtained th[at] on this side of the prime meridian fixed on the occasio[n] and to the north of the Tropic of Cancer every Frenc[h] ship, whatever it may have come and whatever i[t] [illegible], be safe from the pursuit of foreign vessel[s]. Beyond these limits the argument of the strongest was [to] have force. France was at peace with Spain and Portug[al] on this side, at war on the other. A curious state [of] affairs, recalling to some extent the word of Pasca[l]: "Vérité en deçà, erreur au delà!"

And yet have we really the right at this day to lo[ok] on an arrangement of this kind as such a strange one? Have we not now what the casuists of international la[w] call the *état de représailles*, a state in virtue of whi[ch] one may blockade the ports of a nation, burn its arsena[ls] and destroy its armies, without being in declared wa[r] and without ceasing diplomatic relations with it?

The object of the great Minister was evidently to secu[re] a refuge for our marine till such time as it was able [to] contend with others: a goal for which he laboured wi[th] such admirable success that before his death our na[vy] was constituted and the bases laid of that colonial greatne[ss] which came with Louis XIV. and Colbert.

Such, then, was the political motive at work. But [in] pursuing this question of colonial commerce the mind [of] Richelieu was for a moment turned to geography. [He] needed a pure line of demarcation, not liable to be d[is]puted, and found it in the ancient meridian of t[he] Canaries. He resumes the geographical idea of Marin[us] of Tyre and of Ptolemy. He places his meridian as f[ar] to the west as possible in the archipelago of the Canaries in the island of Ferro, and the longitudes are to [be] counted east of it. All the other meridians of the contine[nt] are excluded.

Accordingly, and I insist on the fact, all the qualific[a]tions of a universal meridian, such as science might [be] able to establish at this day, were combined in Richelie[u's] meridian.

(1) It is universal and fit to be so, seeing it personif[ies] no nation, but is, on the contrary, the determination of [a] purely geographical idea; namely, the position farthest [to] the west of the ancient world.

(2) The numeration of the longitudes is very natur[al]. It brings the numerical augmentation of the longitude i[n] harmony with that of the local time. It sets forth [no] negative longitude—a system which, in our opinion, [is] defective, when there is a question of universal numerat[ion] of longitudes.

(3) It places the first meridian in the sea, as geograph[ers] have always desired.

The opportuneness of Richelieu had but one fault: it [was] in advance of its time—not in respect of its utility [or] urgency, but of its means of realisation.

In order to establish a meridian at any point it [is] necessary to be able to connect this point exactly w[ith] all well-known points which are to be brought into re[la]tion to it. Now, by reason of various circumstances, ch[ief] amongst which was the state of war then prevailing, [the] longitude of the island of Ferro was not known till a cent[ury] later, when P. Feuillée, astronomer and naturalist, p[ro]ceeded to the Canaries by order of the King and [the] Academy, and there made observations on the occu[lta]tions of the satellites of Jupiter, whence he determi[ned] the position of Orotava in Teneriffe, and consequen[tly], by means of a triangulation, the position also of the isl[and] of Ferro.

[1] Lecture by Dr. Janssen to the Paris Geographical Society.

conventional position had been
Ferro. In fact, at the beginning
y our geographer Delisle is found
he island of Ferro on his maps

al idea of Richelieu was, accord-
its integrity. Paris, in fact, gave

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forth in the science by always
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lisle and d'Anville placed France
y in the front rank in geography.
France had thus an undisputed
she at the same time took the
drographic methods, and produc-
drographic works, as I had occa-
nce at the Congress.
e labours of France still we not
present activity in the branches
ll say but a word in passing. I'r
plishing great things even at the
on of the port of Rochelle, estab-
found scientific principles; the
n and Atmos ; the great geode-
umed ; the publication of the
al ephemerides, the most com-
ence ; the fair series of determ-
igh precision, undertaken under
s of Longitudes, those which
hich are being [illegible]
and without [illegible] beyond the
us not forget the great enterprises
erywhere vindicates the genius
e seems to spare in the interest of
in all that a sum of sterling sub-
ger to call it to mind at a moment
ng his claims forward?
xplanations made, we may now
ldress ourselves to an analysis of
ington Congress.
ibled by the zeal of the United
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of the different States issued. It
with the task of studying the
meridian and of conceptions [illegible]
propositions, which it is free,
n the Governments represented,
s a basis for further negotiation
s.
n of the American Government
nt of France, the latter applied to
he delegates which should pro-
lly at the Congress. These repre-
rtment of a Grand [illegible]
ive of the Science and School
h the Academy of Sciences [illegible]

presided over by the [illegible]
held numerous [illegible]
he greatest care and [illegible]
composed the [illegible]
The resolution which [illegible]
nulated in a remarkable [illegible]
cepted by the Government, formed
structions given to the French

ed on October 1 in the Diplomatic
nt of State.
hand of the French delegates the
the motions and speeches [illegible] French,
ge should be translated into French,
erbaux should be drawn up in the

two languages. To secure the accuracy of the French version M. [illegible] accepted the duties of secretary.

The Congress invited certain learned men present at Washington to assist at its sittings, and to take part in the discussions. Among these may be named Messrs. Newcomb, Asaph Hall, Sir William Thomson, and Prof. [illegible]

[illegible] the composition of the assembly it will be seen [illegible] England and America were repre-sented [illegible]

[illegible]

debate, and are consequently infinitely freer to express our opinion and discuss the question from the one point of view of the interests of the projected reform.

"The history of geography shows us very numerous attempts at the unification of longitudes, and on searching into the causes of the failure of those attempts, many of them very happily conceived, one is struck by the fact that they seem reducible to two main causes, one of a scientific, the other of a moral nature. The cause of a scientific nature lies in the inability of the ancients to determine exactly the relative positions of points taken on the globe, particularly in the case of an island removed from a continent, where the distance between the two was not determinable by itinerary measures.

"It was thus, for example, that the first meridian of Marinus of Tyre and of Ptolemy, placed in the so-called Fortunate Islands, could not continue to be used, notwithstanding the advantage belonging to the choice of a position at the extreme west of the then known world, on account of the uncertainty attaching to this point of departure.

"This very regrettable reverse served to give a wrong direction to the question. People were obliged to revert to the continent. Instead of regarding a common origin of longitudes indicated by nature, people took their first meridian from a capital, from remarkable places, from observatories. The second cause to which I referred, the cause of a moral kind—namely, national jealousy—led to the multiplication of geographical origins, whereas the nature of things would have demanded their reduction to one single origin.

"In the seventeenth century Cardinal de Richelieu, seeing this confusion, wished to resume the idea of Marinus, and assembled at Paris learned men of France and foreign countries. The famous meridian of the island of Ferro was the result of the conference. Here is a lesson which we ought not to lose sight of: the meridian of the island of Ferro, which had at first the purely geographical and neutral character alone able to render it, and maintain it as, a first international meridian, was displaced from its primary position by the geographer Guillaume Delisle, who, to simplify the [illegible], placed it in round numbers 20° west of Paris. This unhappy simplification completely changed the principle of impersonality. It was no longer an independent meridian, but the meridian of Paris disguised. Nor were the consequences slow in making themselves felt. The meridian of the island of Ferro, from that time regarded as a purely French meridian, wounded national susceptibilities, and thus lost the future which was certainly in store for it had it remained true to its first intention.

"This was a real misfortune for geography. Our maps in their process of improvement ought to have maintained the unity of departure, instead of confusing it ever more and more.

"If from the time when astronomical methods were sufficiently advanced to allow the fixing of relative positions with the degree of precision required for general geography (a state dating from the end of the seventeenth century), the idea of Marinus of Tyre, so just and so geographical, had been resumed, the reform would have been effected two centuries sooner, and we should now have been in the full enjoyment of it. But people fell into the error of losing sight of the very principles of the question, an error to which the foundation and multiplication of observatories at that time greatly contributed. Furnishing relative positions, as they of course did, with great precision, each of these establishments was chosen by the nation possessing it to give it a point of departure for longitudes, so that the intervention of astronomy in these questions of a geographical nature—an intervention which, properly understood, should have been so advantageous—served only to remove us further from the object to be attained.

"The study of these questions leads us to establis[h] a very necessary distinction between the meridian[s] of a geographical or hydrographical nature, and th[e] meridians of observatories.

"The meridians of observatories must be regarded [as] essentially national. Their office is to enable observ[a]tories to depend on each other for the unification of the[ir] observations. They also serve as a basis for geodet[ic] and topographical labours executed in connection wit[h] them. Their functions, however, being of an entirel[y] special character, ought in general to be limited to th[e] country possessing them.

"The first meridians in geography, on the other han[d], do not require to be fixed with a precision quite [as] delicate as that exacted by astronomy; but in retur[n] their domain ought to be comprehensive, and while it [is] serviceable to multiply observatories, it is necessary t[o] reduce to the utmost the origins of longitude in geo[graphy].

"It may further be said that if the site of an observa[tory] ought to be chosen under considerations of a[n] astronomical description, a meridian of departure i[n] geography ought to be fixed on grounds of a geographica[l] description.

"Have these two so different functions always bee[n] well comprehended, and a distinction of such vit[al] moment properly observed? By no manner of means.

"Seeing the observatories, by reason of the labours [of] high precision executed by them, furnish admirable dat[a], each nation in a position to do so has assigned to [its] principal observatory not only the geodetic or topogra[phical] works undertaken at home—a task very proper t[o] it—but likewise the general works of geography or hy[drography] executed abroad: a confusion of function[s] comprising in it the germs of all the difficulties und[er] which we now labour.

"In proportion, therefore, as cartographic labours a[ccu]mulated, the necessity of establishing unity in all tha[t] relates especially to general geography became more an[d] more felt. This explains how the question of a sing[le] meridian of departure has been so often raised in recen[t] times.

"Among the assemblies occupied with this questio[n] that [illegible] the one held a[t] Rome [illegible] the co[n]clusions adopted by the Congress of Rome settle th[e] matter. These [illegible] must, therefore, very partic[u]larly engage our attention.

"On reading the reports of the sittings of that assembl[y] I was struck by the fact that in a meeting embracing s[o] many men eminent for their learning and special[isms] was the [illegible] side of the question which was espe[ci]ally considered, and which finally dictated the sense [of] the resolutions [illegible].

"Thus, instead of laying down the great principle tha[t] the meridian which should be offered to the world as [a] point of departure for all the longitudes of the eart[h] [illegible] to have an essentially geo[graphical] and [illegible] character, the question wa[s] simply asked which among the meridians of observatorie[s] was the one possessing—permit me the expression—th[e] largest following [illegible] *la plus nombreuse*.

"In a question of a geographical, much more than o[f] a hydrographical, interest, as almost all mariners confes[s], [illegible] that, in fact, there exist but two prime hydrograph[ic]al meridians, Greenwich and Ferro, a primary meridia[n] is taken the dominating character of which is marin[e]. And this meridian, instead of being chosen according t[o] the configuration of the continents, is claimed for an ob[servatory]. That is to say, the prime meridian is chosen fo[r] a mere chance spot on the globe, and one which, more[over], is very inconvenient for the function the meridia[n] is intended to perform. Instead, finally, of profiting b[y] the lessons of the past, an element of national rivalry [is]

...stion which ought to unite the votes ...

...onsiderations of economy and of use ...o blind us to the principles which ...estion, and which can alone render ...ally acceptable and permanent. ...rgument of economy, and use, and ...nced as a reason of determinative ... is true, for the majority for whom ... but for them alone, and leaves for ...rden of change in habits, public ...

...holds us of so light account in the ...riefly to recall the past and the ...rography, and for this purpose I ... cite a few passages from a work ..., and emanating from one of our ...ers. 'France,' says he, 'created ...ies ago the oldest nautical ephemer... She was the first to conceive and ...odetic operations having for their ...on of maps civil and military, the ...al arcs in Europe, America, and ...rks were and are regulated by the ... Almost all the astronomical tables ...s and mariners of the entire world ...day are French, and calculated in ...*dian of Paris*. As regards the me... *...ly marine* surveying, the precise ... *the present* day by all the nations ... *and* our maps, all based on the ... names such as those of Beautem... Fleurieu, Borda, d'Entrecasteaux, ... Duperrey, Dumont d'Urville, ... but a small number of those who ...

...rographical collections count more ... Deducting from this number those ... exploration has rendered no longer ...n about 2600 charts in use, ...more than a half represent original ... foreign nations have in great part ... remainder the general maps in the ...s of dimension carried out in the ...all documents French is much as ..., and relatively few of them are the ...t simple of foreign [illegible] ...ted to the coasts of the [illegible] ... hardly a region on Newfoundland, ...ess original labours [illegible] ... of Brazil and La Plata [illegible] ... Japan and China [illegible] ... Ocean. We must [illegible] ... of our hydrographers [illegible] ... Italy, which [illegible] ...th the grand medal of honour [illegible] ... of 1875. The exclusive [illegible] ...ridian of Paris [illegible] ... of 200 years [illegible]

...f another prime meridian would ... the graduation of the [illegible] ...ould involve a similar [illegible] ...nstruction numbering [illegible] ...ental a corresponding [illegible] ...*aps*.

...derations deserving to be [illegible] ... condemn the projected [illegible] ...ed by the high principles which [illegible] ... is to take for its basis [illegible] ... of the largest number [illegible] ...choice, reserving for [illegible] ...and the abandonment of [illegible]

glorious past, are we not, then, justified in saying that a proposal formulated in this sense would not be acceptable?

"When at the end of the last century France established the metre, did she proceed in this way? Did she, as a measure of economy, and not to change anything in her habits, propose her foot rule to the world? You know the facts. The truth is, we turned everything at home topsy-turvy, habits and material. And the measure chosen related, as it is, only to the dimensions of our globe, [illegible] well disengaged from every French tie that in future even the traveller who will trample on the ruins of our cities will be able to ask himself by what people was invented the metrical measure which his feet may chance to light on.

"Permit me to say that it is in this way a reform is established and rendered acceptable. It is by setting oneself the example of self-sacrifice and by completely effacing oneself in his work that resistance is disarmed and that a [illegible] love of progress is [illegible].

"I hasten to say that I am persuaded that the proposal voted at Rome [illegible] made me suggested by England, but I doubt whether, if accepted, it will render a true service to the English nation. An immense majority of the sailors of the globe navigate with English charts, it is true, but [illegible] homage of [illegible] rendered to the great maritime activity of this nation. The day, however, when this superiority [illegible] freely accorded, is changed into a supremacy [illegible] and imposed, it will undergo the vicissitudes of every human power, and this institution, which by its nature [illegible] of a purely scientific order, and to which we [illegible] a long and peaceable future, will become an object of keen and jealous rivalry among the nations.

"All this shows how much it [illegible] take for the origin of terrestrial longitudes a point determined by purely geographical considerations. [illegible] the [illegible] in which the [illegible]

[illegible]

## GUESSINGS AT TRUTH

I.

OLD SPENSER, in his wondrous Allegory, tells us—

> ". . . he, that never would,
> Could never.—"

We are constantly reminded that we must creep before we can walk. So that we cannot look coldly or sarcastically on

> ". . . budding Genius' earliest essaye,"

provided always that we are sure of the earliness. For there often is a strange resemblance between the erratic first flights of the scientific fledgeling and the habitual evolutions of the time hardened Paradoxer or of the Paper-Scientist.

Besides the mere dozen or so of really successful Physicists, all that the world seems able to produce at any one time, even in these later years, and whose efforts can at the best be rarely called more than *Guesses*, there is an untold multitude whose *Guessings* are irrepressible. These, unlike some at least of the former, never hide their light under a bushel. From week to week we view with curious awe the increasing piles of pamphlets under which our shelves and table sag, groan, and crack! Let us make an effort, and get rid of some of them. Not to the waste basket—at least not at once for there is something in almost every bundle of hay (in the Sunday it is not needles, but bricks and slags), and this is usually worth searching for, were it only in the interests of justice to those who have thus (unconsciously?) hidden them. We take the bundles as they come; many are rotten and can be tossed aside at once, others require more careful scrutiny.

The first we light upon is by our particularly modest contributor John O'Toole.[1] [He does not seem to be aware of the powers of Peroxide of Hydrogen, which (though we did not proclaim the fact) enabled us on a former occasion easily to penetrate his *incognito*. But his secret is safe with us.] His present work is a singularly quaint protest against the modern abuse of elementary dynamical terms, and as such is well worthy of careful perusal. There can be little doubt that, of all physical subjects, as presented in an elementary form to the beginner, Dynamics is the most repulsive. And it stands at the very threshold. Mr. O'Toole shows the natural working of a clear, logical, mind in the middle of the present chaos. His pamphlet is one which should be read by all: for, though he hits all round and sometimes attacks the very giants of Science, he invariably hits fair as well as hard. It would take a whole article to discuss fully the questions he raises: suffice it to say that the root of the confusion which he so justly exposes is that little, but much-abused word *Force*; and to quote the following pregnant sentence as showing his point of view:—

> "When we behold . . . a group or sequence of phenomena, we *invent force* among them *to ourselves*, because we know from experience that if our organism were substituted for the acting or resisting body, we should have the sensation of pressure."

Next we take a couple of smaller, but more ambitious, pamphlets[2]: in each of which the Past, Present, and Future of the Universe are promptly settled, though the terms of settlement are by no means identical. When we find, however, that Herr Zehnder, in the second sentence of his pamphlet, says that insuperable objections can be raised against the hypotheses of Helmholtz as well as against those of Kant, Herschel, and Laplace, *because they take too little account of the existing laws of mechanics*, we begin to understand him and we have only to turn over a few pages to find him thoroughly revealed. His bugbear is the Dissipation of Energy:—and he informs us that the "Eternal Circulation of Matter"—in virtue of which all aggregations such as the sun will ultimately explode into their former nebulous condition to recommence their condensation, &c.,—is an immediate consequence of THE PRINCIPLE OF THE CONSERVATION OF LIGHT!

Our rival author sums up *his* Kreislauf as follows:—

> ". . . life, matter, and all things, are the necessary and inevitable outcome of the existence of Space. Space or Room, in any form whatever, must of necessity be a form of force or energy, and all things are just phases or manifestations of the working of this force or energy; the Earth is dissolving in Space like a lump of Salt in Water, but New Worlds are being formed in Suns; this dissolving and forming process will go on for ever and consequently life will be eternal; . . ."

This is a step in advance even of Descartes, with whom Space and Matter were the same. We leave to the reader to judge which of the two has the more grotesquely ground through the horse collar, the German Swiss or the Scotsman.

Our next step is a large one, no less than from the Universe to the Atom.[1] The work now before us is a very curious one. The author has hunted widely for his materials, and (very naturally) selects such only as suit his theory. So long as he can utilise Sir W. Thomson or Clerk Maxwell he does so; but, when he finds their statements incompatible with his theory, he has no difficulty in picking up what he wants from Zeuner, Ruhlmann, Hesehus, &c. He seems, however, not to be acquainted with the elaborate work of Athanase Dupré. This is unfortunate, for in it he would have found little difficulty in obtaining whatever he might require. The object of the essay, briefly stated, is to frame a theory of the liquid and solid states, somewhat on the lines of the kinetic gas theory: only it seems we must have a mutual force between particles, whose law is something between the inverse 4th and inverse 5th powers of the distance. But somehow the law itself seems to vary with the distance so that "we must apply the theory of probabilities to determine the potential at any centre due to the surrounding atoms." As a striking instance of Mr. Whiting's extensive range of quotation, we note that he refers, for the sum of a common series (given everywhere in elementary text-books of Trigonometry), to no less august an authority than Riemann in his *Partielle Differentialgleichungen*! We do not venture farther to criticise the work of a writer who can, as a matter of course, invoke such irresistible authorities.

We now come to a whole series of memoirs, tracts, letters, and pamphlets (usually of American origin) which deal specially with the vexed question of the Sun's temperature. From these we select one only, as the work of the most persistent (if not the most lucid or successful) of the many mere guessers on this subject.[2] For the others consult Van Nostrand's *Engineering Magazine*, *passim*. Something, if not very much, has been done in this matter in Europe. Pouillet, J. Herschel, Crova, Rosetti, Violle, and others have at all events gone to work in a scientific way—though (as is obvious from the results of Prof. Langley recently given in our columns) the values obtained by them can be but very rough approximations. A few of Mr. Ericsson's weightier sayings will pretty well show the value and character of his treatise. At p. 58 we are told that

> ". . . the actinometer merely shows the thermometric interval of solar intensity on Fahrenheit's scale, without reference to the position of that interval on a scale which commences at the accepted 'absolute zero.' I regard this absolute zero, however, as an *ignis fatuus*, retreating as fast as we approach it."

[1] *Mens Dynamica.* Dublin: Hodges, Figgis, and Co., 1884.

[2] *Ueber die Entstehung des Weltalls und den ewigen Kreislauf der Welt[?]*. Von L. Zehnder. (Basel, 1883.) *On the Future of Life, and the Universe according to Science.* (Dundee: W. & D. Drummond, 1885.)

[1] *A New Theory of Cohesion, &c.* By Harold Whiting. (Cambridge, U.S.: University Press, 1884.)

[2] *Solar Heat and [illegible] from a [illegible] on "[illegible]."* By John Ericsson. (New York, [illegible].)

The little kinematical, or rather quasi-corpuscular, *excursus* to which pp. 71–74 are devoted, is one of the richest pieces of *paradoxing* (in De Morgan's sense) that we have ever met with. Here is a little bit of it:—

"Pouillet, having ascertained the number of thermal units imparted to the water in his pyrheliometer of 3·93 ins. diameter, imagined that he had measured only the energy of the rays contained in a pencil of 11·9 square inches section; whereas, in reality, he had, at the end of his experiment of five minutes' duration, subjected his instrument to the action of the entire number of rays contained in a passing pencil or sunbeam, the section of which we ascertain by multiplying the orbital advance of the earth during five minutes, 28,836,000 ft., by the diameter of the pyrheliometer, 0·305 ft."

Thus it is the *number* of rays, not the time of exposure to one ray, which determines the result!

One more quotation, a very short one, must be given. It is from p. 136, and we put two words in italics:—

"In view of the fact that projectile force *diminishes inversely* as the square of the depth of the medium penetrated. . . ."

It is not easy to fix on the exact meaning of this very curious statement. Hence we must take it literally, whatever be the consequences. Discussion of penetration would obviously be useless in such a case, for the whole projectile force (even were it infinite) would be gone before penetration had commenced!

The immense expense which has been lavished on this volume, and on its truly wonderful illustrations, is calculated to produce reflections even more painful than those evoked by the perusal of the text itself. From the materials here given, *something* may yet be made, but certainly not on the lines chosen by the author.

We hope, shortly, to return to our store, and to select for the instruction and warning of our readers a few additional specimens, by no means inferior in quality to those just dealt with. G. H.

## *PROFESSOR FLEEMING JENKIN, LL.D., F.R.S.*

ON Friday last, most unexpectedly and greatly to the grief of all his friends, died Prof. Fleeming Jenkin at Edinburgh, at the age of fifty-two. He had been in somewhat delicate health for a considerable time, but was, as usual, personally directing the engineering operations in connection with telpherage in London and Sussex, and seemed to have greatly gained in health and strength when he started for Edinburgh some days before his death. But blood-poisoning succeeded a slight surgical operation, and his death rapidly followed.

He was born in Kent in 1833, and was the son of the late Capt. Charles Jenkin, R.N. His school-days were spent at Jedburgh, Edinburgh, and Frankfort-on-the-Maine, while he took his M.A. degree at the University of Genoa, and began his engineering career in Marseilles, thus acquiring a wide knowledge of languages and of peoples which was most valuable to him afterwards in his scientific and social life.

In 1851 he returned to England, and was apprenticed to Messrs. Fairbairn's in Manchester, from which time his progress was rapid. We hope that the interesting and highly creditable history of his subsequent introduction as a well-trained mechanical engineer to submarine telegraphy (then in its extreme youth) and to Sir William Thomson, which led to his soon taking charge of the testing of the first Atlantic cable in 1858, and to a friendship and partnership with Thomson and Varley, will yet be told by some one who can do full justice to it. Our grief at Varley's loss is yet fresh, and we deeply sympathise with Sir William Thomson at the close of this partnership, the existence of which has been synonymous with the progress of submarine telegraphy.

On the appointment of the Committee of the British Association on Electrical Standards Jenkin's services were solicited, and the good work that he did as a member of this Committee is amply shown by his large contributions to the Reports on Electrical Standards, and which contain an account of his absolute measurement of the capacity of a condenser, the first such determination ever made; and the chapters that he wrote in connection with these Reports on the subject of "Absolute Units" formed the only available text-book for the student of mathematical electricity before about the year 1872. Appended to these reports are the Cantor lectures which he delivered on the construction, laying, and testing of submarine cables, and these lectures showed as wide an acquaintance with the practice of electrical science as do the other chapters referred to with the theory of the subject.

In 1865 he was elected a Fellow of the Royal Society and Professor of Engineering in University College, London, and in 1868 he became Professor in the University of Edinburgh, where he created a School of Engineering to which considerable numbers of prominent Engineers and Professors of Engineering acknowledge their indebtedness. In the following year the Royal Society of Edinburgh elected him a Fellow, and subsequently he became a Member of the Institution of Civil Engineers, having been made an Associate of that Institution as early as 1859. In 1883 the honorary degree of LL.D. was conferred on him by the University of Glasgow.

Jenkin's book on Electricity and Magnetism, published in 1873, was a revelation to non-mathematical and even to many mathematical men, of the ideas which had until then been wrapped up in the mystery of mathematics or in the practice of the submarine cable testing-rooms. Sir William Thomson had been publishing many detached papers on electricity in the mathematical journals, and had been applying his knowledge in practice, so that an exact science of electrical quantities had been growing up among submarine cable engineers; but the electricity of the text-books remained as unscientific and primitive as of old: the knowledge of the practical men had become indeed far more scientific than the knowledge of the schools.

Fully recognising this, Prof. Jenkin made in his book a totally new departure, and presented electricity and magnetism for the first time in a text-book as subjects capable of quantitative study. To understand the great effect produced by this book, which has now passed through many editions, it must be remembered that neither Clerk-Maxwell's treatise, nor Thomson's reprint of his Mathematical Papers appeared until 1873, and that at that time "electric potential," which to-day has its commercial unit, was to every one, except the engineers of submarine telegraphy, a mere mathematical function.

In 1882 a lecture was delivered at the Royal Institution on Electric Railways, and the system devised by Profs. Ayrton and Perry for effecting an absolute block, and thus enabling any number of electric trains to be run without the employment of drivers, guards, or signalmen, was described and exhibited by a working model. An account of this was read by Prof. Jenkin, and he at once saw that it contained the solution of a plan that he had been thinking over for doing on a large scale by electricity what had previously been done on a small scale with pneumatic tubes. *Telpherage*, or the automatic electric transport of goods, was the outcome, and the development of practical methods of running carriers electrically along a steel rod suspended in the air from wooden posts, occupied him, with the other two inventors, during the last three years of his life, the system being one which needed new invention in every one of its details. His inventive power is described by his assistants as wonderfully active and prolific, and he had energetic characteristics which only seldom accompany inventive genius, and which made his cooperation invaluable to the other directors of the Telpherage Company. It is deeply to be regretted that, having busied himself so actively in the long series of telpherage expe-

[illegible]

... has recently been renewed under the clerical Government now in power, and unfortunately with more success. From the published debate it is clear that the Minister in whose department the estimate for the Geological Map was prepared, and who was officially bound to support that estimate, sat still without speaking in its defence, and the House, taking this silence, no doubt, as an expression of the inclination of the new Government, threw out the vote. We are sure that this retrograde step will be regretted by all who wish well to the progress of science. Into the personal squabbles connected with the subject we have no wish to enter. But as a public act of administration the vote of the House of Representatives will, we hope, be rescinded and the prosecution of the Survey will be again allowed to proceed. If any fault is found with the way in which the map has been prepared, surely the Commission contains talent and energy enough to inquire into this and set matters right without practically bringing the Survey to a stand.

## *THE CONGO*[1]

THESE two welcome volumes from Mr. Stanley testify to the accelerated rate of events in these latter times. It is only twelve years since Livingstone died in the vain search for the sources of the Nile down by Lake Bangweolo, and under the belief that no river but the Nile could sweep past Nyangwe with such a breadth and volume as he found the Lualaba to have. He was not singular in cherishing such a belief; many geographers believed, like him, that the Congo could not fetch such a sweeping circuit, and that the Lualaba must make its way northwards in spite of difficulties of level and somehow add its waters to the Albert Nyanza. It is only eight years since Mr. Stanley dispersed the delusion, and solved the problem both of the Nile and the Congo; it is just about six years since he began operations as the agent of the International African Association. To judge from the narrative of his journey across the continent, there was no blacker part of the Black Continent than the river banks between Nyangwe and the Atlantic, and no more intractable people than many of the tribes through whom he and his men had to run the gauntlet. Yet already, almost solely by his exertions, this most unpromising region has become "A land of settled government," at least on paper. It has engaged the continued attention of diplomatists from all the great States of the world for months, and is the subject of as many treaties as if it had been founded a century ago.

In reality, however, it is something more than a paper State. No one can read Mr. Stanley's narrative without being convinced that all along the river from Vivi to Stanley Falls there already exists what may fairly be regarded as an organised Government, carried on from some twenty-four stations as centres. But with the merely political aspects of this successful undertaking we cannot deal here. It is certainly an interesting experiment, both from a political and social point of view, this attempt to raise into a State a region not yet redeemed from savagery. What the ultimate result will be it is hard to say; on the one side a great mass of savagery, and on the other the most advanced European influences in politics, in commerce, in industry, in religion. For already we find bands of missionaries everywhere, and as among them are many men of prudence, tact, and ability, Mr. Stanley acts wisely in encouraging their efforts; they will certainly be of service in helping him to accomplish the object he has in view.

Without the aid of the latest applications of science, Mr. Stanley could never have succeeded in accomplishing all he has done in the brief period of six years. Steam has been of infinite service to him, and engineer-

[1] "The Congo, and the Founding of its Free State." By Henry M. Stanley. Two Vols. (London: Sampson Low and Co., 1885.)

ing contrivances in many ways. His flotilla of steamers, some of them most ingeniously contrived for the special navigation of the Congo, may be said to have been everything to him in carrying out his work; and the Congo Free State may be fairly set down as another "triumph of steam." Mr. Stanley claims for the Congo Free State an area of over a million square miles and a population of 42,608,000. As to the area, that is probably not far out; but the population seems to us excessive. Mr. Stanley reaches this great figure by generalising the density which he finds on the banks of the river itself. Between Stanley Pool and Stanley Falls, a distance of about 1000 miles, and including part of the Biyerré and Kwa Rivers, he finds a population of 806,300, and takes for granted that a similar density will prevail throughout the whole of the Congo Basin. This is very unlikely. In uncivilised countries the population naturally crowds itself along the river banks, and it would be very unsafe to calculate on finding regions at a distance from rivers equally well populated. Throughout the whole of the million square miles claimed by the Congo State only a few lines of exploration have as yet been run, though we know that as a whole it is probably the best-watered region in Africa, and possibly therefore the most thickly peopled. But the tendency among African geographers recently has been to reduce previous estimates of the population of Africa, and instead of 200 millions it is thought that 170 millions is one more likely to be nearer the mark. But all estimates, except for districts that have been settled for some time, are necessarily conjectural; and even for Morocco the greatest difference exists between the estimates of different travellers.

On the Lower Congo the Free State has been able to secure only a comparatively narrow strip of territory on the north bank—enough, however, to give it the right of free navigation between the sea and Vivi, where the first series of cataracts begin. From Vivi upwards to Manyanga the State possesses territory on both sides, when France comes in and claims the whole of the right bank of the river to the Likona tributary in 1° S. lat. Thence the Free State expands into boundless and unknown regions, which we hope it will do its best to explore and open up to science as well as to commerce. The aim in the north has been evidently to draw the boundary of the

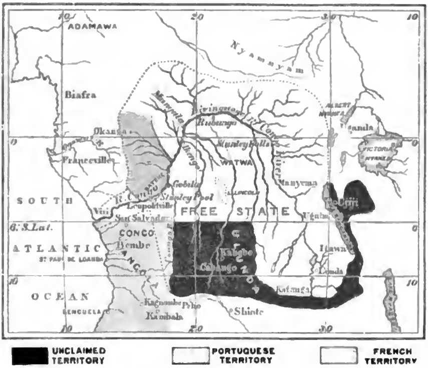


FIG. 1.—Political Divisions of the Congo Basin.

State between the basins of the Nile and the Congo. The western basin of the Upper Nile, no doubt, is fairly well known, but the region between that and the Upper Congo is just that part of Africa about which we know scarcely anything. The boundary on this side, therefore, has been drawn with the freedom of conjecture. All the rivers that are not known to send their waters to the Nile must, in Mr. Stanley's opinion, come down to the Congo, or, at least, ought to do so, and are made to conform with Mr. Stanley's idea of what is right and proper, in the large map which accompanies his work. In spite of Dr. Junker's discovery of the water-shed which separates the Nepoko from the Welle, they are both made to send their waters southward to swell the magnificent Aruwimi. This may be so; only actual exploration will decide the matter. It is mainly to settle this question that Dr. Lenz is preparing to proceed to the Upper Congo as leader of an expedition into the region that lies between that region and the Upper Nile tributaries. And here we have one very beneficial result of the work which Mr. Stanley has done on the Congo. His numerous stations form so many starting-points for further exploration. They can be easily and rapidly reached from the West Coast, and through the agencies at their command, all the men and goods obtained necessary for the conduct of an expedition into the interior. If every station on the river were made the basis of further exploring work, one of the greatest blanks in our knowledge of Africa would soon be filled up. In the interest of the enterprise itself this must be done. If the manifold products of the wonderful land over which Mr. Stanley is so enthusiastic are to be brought down to the river for shipment to the upper terminus of the future railway that is to convey them past the cataracts, it is evident that station after station must be pushed on into the interior. Among the white *employés* of the Association are many men of education and intelligence; and while their first duty is to look after the interests of the "Free State," these interests, instead of suffering, are likely to be advanced by a scientific knowledge of the country around the States. Already good meteorological work has been done at Vivi by Dr. Danckelmann, whose recently publish

Fig. 2.—Yellala Falls from Left Bank.

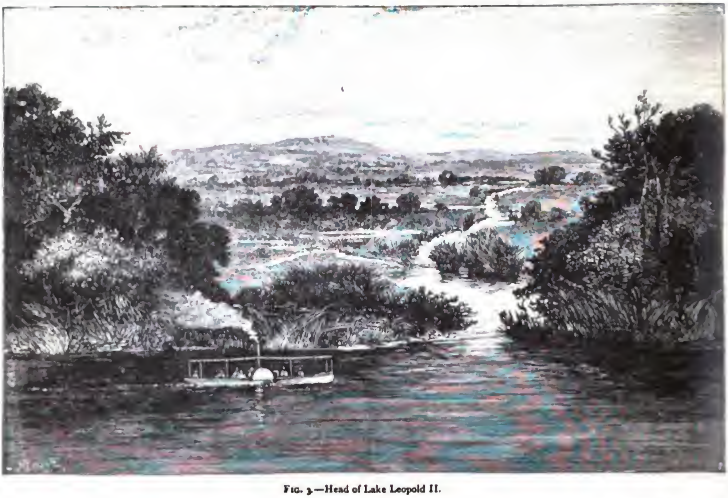

Fig. 3.—Head of Lake Leopold II.

observations we reviewed some time ago. The utility of such observations is evident from the volumes before us. Mr. Stanley makes considerable use of them in his chapters on the Climate of the Congo. These chapters are of much interest; they are written mainly with a view to show that, with reasonable precautions, Central Africa ought to be perfectly tolerable to the European constitution. What these precautions are he describes in minute detail. At the same time he admits that a lengthened residence in such tropical regions must in the end tell on

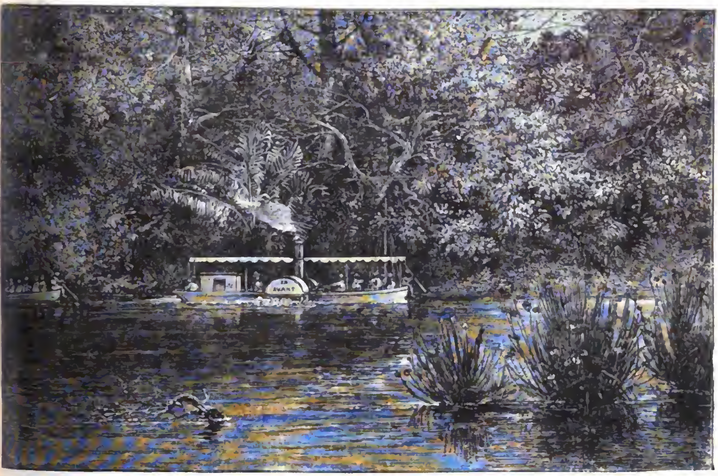

FIG. 4.—Banks of the Upper Congo.

the Europeans, and is only possible with a run home every eighteen months. Thus it is clear that if the resources of the Congo are to be developed, it must be by native labour, and there is therefore every inducement to treat the population humanely.

Of course, Mr. Stanley himself in his frequent journeys

Fig. 5.—A Type of the Basoko.

up and down the river has added considerably to our knowledge of it. His original sketch of its course, made in one rush downwards, seems, however, to have been wonderfully accurate; though the hundreds of observations as to direction, altitude, depth, and width has enabled him to lay it down with much greater precision. It is to be hoped that the geology of the basin will be well worked out, and even from a "utilitarian" standpoint it might be useful for the Association to engage one or two competent men to work out the geology. The numerous cataracts on the lower as well as on the upper river prove that there is much here to interest the geologist. On the lower river, just where the great central plateau begins to shelve down to the coast, they are to be expected; but what is the exact geological explanation of the numerous cataracts on the upper river and its tributaries, as far south as Bangweolo, let us hope, will ere very long be explained. The banks of the river itself are in many places remarkably picturesque; indeed Mr. Stanley would make us believe that he thinks no other river is equal to it in this respect. Magnificent bluffs, he tells us, are met with in many places, and gorges that are almost *cañons*. At Stanley Pool and elsewhere the river has broadened out into lake-like reaches studded with islands, and at one place a few miles south of the equator there is a complicated offshoot of lakes and streams which reminds one of what is observed in so many places on the Central and Lower Amazon. This stretch has not, however, been completely explored, though Mr. Stanley's account of his journey up the Kwa and Mfini to Lake Leopold is one of the most interesting chapters in the volume. The Kwa discharges at about 3° S. lat., and Lake Leopold, Mr. Stanley joins conjecturally to Lake Montumba, which is connected with the Congo at about fifty miles south of the equator.

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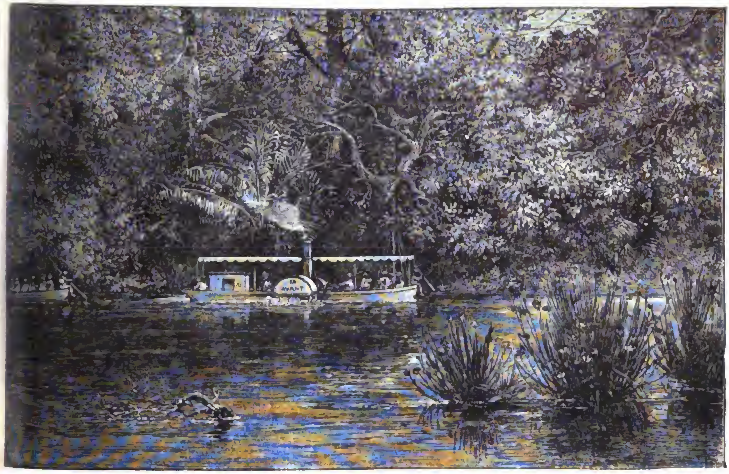

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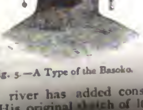

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With regard to the volume of discharge of the Congo, from careful observations made at Stanley Pool, Mr. Stanley calculated that it reached 1,436,850 cubic feet per second when the river at that point was at its lowest. During flood it rises, he believes, twelve feet higher, giving a volume of 2,529,600 feet per second. If these estimates are correct, then Mr. Stanley calculates that the river discharges into the sea three million cubic feet of water per second.

Mr. Stanley's new work is so fully occupied with the details of the founding of his numerous stations, his dealings with chiefs and people, his road-making and other engineering enterprises, and the general work of engineering the enterprise, that there is little space left for geographical details. He does give a list of the products of the Upper Congo region, but as this is entirely from a commercial standpoint, its value to science is not great. The various species of palms, as might be expected, abound on the banks of the river and its islands, the oil-palm being the most valuable from a commercial point of view. Then come the various species of india-rubber plants, besides other gum-producing trees. Ivory, Mr. Stanley reckons only fifth in rank among the natural products of the Congo. He presumes that there are

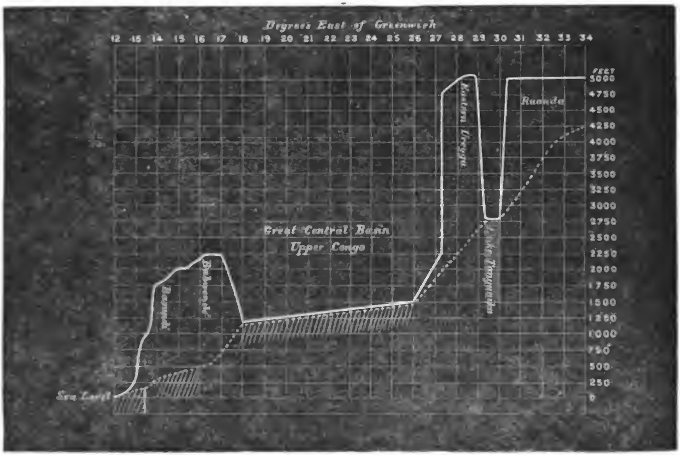


FIG. 6.—Profile of Country between the Sea and Ruanda, across the Congo Basin.

almost 200,000 elephants in about 15,000 herds in the Congo basin, each carrying an average of 50 lbs. weight of ivory in his head. Iron, he tells us, is abundant. The copper mines near Philippeville supply a large portion of Western Africa with their ingots. Plumbago is also abundant, and gold has been found in the beds of streams. Mr. Stanley gives a long list of tropical plants which abound in the Congo basin, while several European vegetables and fruits have been found to thrive. The Arabs, moreover, he tells us, are introducing the large-grained upland rice with extraordinary success. He adds many details concerning the trade, actual and possible, of the Congo region, his object, of course, being to show that here exists a magnificent field for the European trader, European capital, and European settlers.

Mr. Stanley's work is chiefly of value as telling the story of one of the most unique and interesting enterprises on record. This story he tells with abounding interest; there are many incidents throughout the volume told with the dramatic effect so well known to readers of "Through the Dark Continent." The work of founding the Free State has been well begun, but it is only the beginning; for the sake of its complete success it is to be hoped that nothing may occur to sever Mr. Stanley's connection with it until it has been firmly established.

## *NOTES*

THE Royal Society's *conversazione*, held on the evening of June 10, was a very great success, and those who had the labour of bringing the various things together must have felt themselves amply rewarded by the great interest taken in them b[illegible] and guests, both ladies and gentlemen, who [illegible] the objects exhibited we may note the [illegible]gical map (unpublished) of Palestine and Arabia Petræa, exhibited by Prof. Edward Hull, F.R.S.; original drawings of the skeletal, digestive, and vocal organs of birds, made in the years 1842-46, drawn and exhibited by Prof. W. K. Parker, F.R.S.; Sketches of the eclipse of the moon, October 4, 1884, and a very beautiful series of sketches of the wonderful sunsets and after-glows, painted and exhibited by Mr. W. Ascroft; star-charting by photography (enlarged prints from negatives made in 1883 and 1884), exhibited by Mr. A. A.

Common, F R.S.; electrical influence machine, exhibited by Mr. James Wimshurst; New microscope with novel fine adjustment and sub-stage arrangements, exhibited by Mr. Crouch; large Nicol prism polariscope, for projecting axes of crystals, &c., on the screen (improved form), exhibited by Messrs. Harvey and Peak; Tate's calculating machine, exhibited by the inventor. By means of this machine long operations in the fundamental rules of arithmetic can be performed with rapidity and unfailing accuracy. Eight figures can be multiplied by eight figures in about fifteen seconds. New forms of spectroscopes, exhibited by Mr. A. Hilger; photographs of fractures of railway carriage and waggon axles, tested to destruction by Mr. Thos. Andrews, Wortley Iron Works, near Sheffield, exhibited by Mr. Andrews; three cases of living animals: (1) Examples of the Tuatera (*Sphenodon punctatus*) from New Zealand. This reptile is remarkable as deviating from all the lizards in its osseous structure, and is considered by Dr. Günther (*Phil. Trans.*, 1867, p. 620) to constitute an order by itself—*Rhynchocephalia.* (2) Large bird-eating spider of the genus *Mygale* from Burmah—probably *M. fasciata.* (3) Butterflies and moths, showing the way in which living insects are exhibited in the Zoological Society's Insect House, exhibited by the Zoological Society of London. A series of microscopic sections of vegetable tissues, prepared and lent by Mr. J. E. Sunderland, of Hatherlow, near Stockport, showing remarkable effects of double and triple anilin staining; a series of botanical microscopic preparations, mounted by Charles Vance Smith, of Carmarthen, being part of a series prepared by him to illustrate the text-books of Julius Sachs and Otto Thomé, exhibited by Prof. Moseley, F.R.S. A series of slides with stained specimens of *Tænia echinococcus* of the dog, prepared and lent for the occasion by Dr. J. Davies Thomas, of Adelaide, Australia, in illustration of his paper on the artificial rearing of this parasite by feeding with human hydatids (to be read before the Royal Society, June 18); a slide showing the same species of tapeworm, reared by Mr. Edward Nettleship, F.R.C.S., by means of hydatids obtained from the lungs of a sheep (*Proc. Roy. Soc.*, 1866). To compare with the above:—Specimens, in bottles, of *Tænia serrata*, *T. marginata*, and *T. cœnurus*, &c., artificially reared by Dr. Cobbold, by feeding dogs with the scolices appropriate to each particular species. Also adult examples of *Tænia cucumerina* and of *T. canis lagopodis* (*T. littera a*), the latter from Iceland, prepared by Dr. Krabbe, *Bothriocephalus dubius*, and other species from the cat and dog, exhibited by Dr. Cobbold, F.R.S. Case of gems, including a great Indian diamond, the largest known opal, a series of cat's eyes, and allied mineralogical specimens, exhibited by Mr. Bryce Wright, F.R.G.S.; "Frith's Selenium Cells," showing the alteration of resistance and photo-electric currents due to the action of light on selenium, exhibited by Prof. W. Grylls Adams, F.R.S; a sulphur cell, the electrical resistance of which, like that of selenium, is reduced by light, exhibited by Mr. Shelford Bidwell. The sulphur has been heated while in contact with silver, and therefore contains some sulphide of silver. The electrodes are of silver. The original integrating machine, invented by Mr. C. V. Boys; engine-power meter which has been developed from the same, exhibited by Mr. Boys.

WE give in another column, on the *audi alteram partem* principle, the first part of an address recently given by Dr. Janssen, putting before us the French view of the Prime Meridian question. It will be gathered from it that the feeling in France is strongly against the conclusion at which the Washington Congress arrived. Taking the world as it is, however, much as a strictly neutral prime meridian might be to be desired, the general opinion will probably be that the Congress arrived at the only *practical* solution.

WE are glad to see that University College, Liverpool, is about to appoint a Professor of Engineering. An endowment of 375*l.* has been raised, and the advertisement of the Chair appears this week in our pages. We understand that a certain amount of professional work, such as is consistent with a due fulfilment of the duties of the Chair, will be permitted, and recognised as enabling the Professor to keep himself in touch with the life of the practical world. The College already has endowed Chairs of Mathematics, Physics, Chemistry, and Biology, in addition to the Literary and Medical Departments: it has lately become a part of the Victoria University, and in many ways it shows signs of health and vitality.

IN the production of the first part of the Philological Society's new English Dictionary, the editor, Dr. Murray, was obliged to advance 150*l.* out of his own resources, and, further, to incur a debt of 500*l.* The delegates of the Clarendon Press, who are publishing the Dictionary, decline to contribute more than 100*l.* towards the payment of this debt, and the Council of the Philological Society deem it their duty, therefore, to appeal to the public to relieve Dr. Murray from a debt incurred on behalf of what is really a national undertaking. It is to be hoped that there will be no difficulty in obtaining the sum required; those of our readers who are inclined to help should send their subscriptions to Mr. Benjamin Dawson, the Mount, Hampstead, London, N.W.

THE Spanish Commission of Medical Inspection has examined the composition of the liquids and virus employed by Dr. Ferran against cholera. The opinion of the majority of the members is that the presence of Koch's *Bacillus virgulus* cannot be questioned. After some opposition, the Spanish Government granted the necessary authorisations for inoculation, which has been practised on a number of doctors and four newspaper writers. It is said, moreover, that all the inoculated patients experienced during the first twenty-four hours after the operation all the symptoms of cholera with more or less intensity, but without any fatality having occurred. When twenty-four hours had elapsed, a favourable reaction took place. The question which remains to solve is the extent of the protection resulting from Dr. Ferran's system. The numbers given are in favour of the new theory, but all the documents coming from Spain on cholera must be received with caution, owing to the intense panic prevailing in that country since the last outbreak of the plague was noticed in Valencia. A fact curious to notice is the tendency of the rural populations of this province to congregate in the cities in spite of all the measures taken against this exodus. *El Imparcial* states that not less than 7000 people have located themselves in the chief city.

PROF. PASTEUR, the *Standard* Paris correspondent states, has published an interesting letter from Dr. Ferran, concerning vaccination for cholera. In this letter Dr. Ferran asserts that the results obtained become every day more irresistibly eloquent. The experience of Alcira had been confirmed in numerous other towns. Anti-cholera vaccination had been practised upon all classes of society, but in many places the greater number of those operated upon belonged to the pauper class, and the results proved no less satisfactory. While of opinion that one inoculation is effective, Dr. Ferran recommends that it be repeated, in order to make assurance doubly sure. In reference to the official prohibition of vaccination for cholera (which has since been cancelled in deference to public opinion), Dr. Ferran intimates that the measure was taken in consequence of two persons belonging to an already cholera-visited family dying the day after [illegible] These casualties Dr. Ferran attributes to the [illegible] lymph, and states that in 16,000 cases, for whic[illegible] sonally inspected the lymph, no evil results had [illegible] not claimed that vaccination for cholera will give actual immunity, but that it will alleviate the attack whenever it may come. Anti-cholera vaccination, affirms Dr. Ferran, can never itself be the cause of an attack. If an attack comes within five days of vaccination it must have been previously contracted. Dr. Ferran attributes the discovery of anti-cholera vaccination to the theories of Prof. Pasteur.

DR. CORNISH, known for his investigations into the nature of cholera, has proposed (according to *Allen's Indian Mail*) that as between 300 and 400 persons are every year judicially sentenced to death in the Indian Empire and its dependencies, a number of these, say one-tenth, be made, with their own full knowledge and consent, subjects of experiments as to the spread of cholera, on condition that if they escape their lives be spared. An international commission of experts might, he suggests, be appointed to determine upon the experimental tests needed to ascertain if cholera is or is not a disease capable of being communicated from person to person. This would do more in the space of a few months to help forward the inquiry into the nature of cholera than has been accomplished by indirect observation during the last century. But if the principle underlying this proposal is admitted by the Indian Government, it might be extended to other most important experiments, such as the various causes and cure of cholera, the cure for snake-bites, hydrophobia, and the like.

THE following is an official statement of the number of visitors to the Whitechapel Fine Art Exhibition during the time it was open in March and April last:—Saturday, March 28, 1008; Sunday, March 29, 2494; Monday, March 30, 2622; Tuesday, March 31, 3332; Wednesday, April 1, 3292; Thursday, April 2, 1823; Good Friday, April 3, 3703; Saturday, April 4, 3269; Easter Sunday, April 5, 2717; Easter Monday, April 6, 4332; Easter Tuesday, April 7, 3720; Wednesday, April 8, 2944; Thursday, April 9, 2872; Friday, April 10, 1942; Saturday, April 11, 3348; Sunday, April 12, 3345; total for 16 days; 46,763. The Exhibition was opened in the afternoon of March 28, admission being by ticket only until 6 p.m., 6 to 10 p.m. free; after that it was opened free from 10 to 10 daily (Sundays 2 to 10).

AT the meeting of the International Committee of Meteorology (instituted by the Congress held at Rome) in the beginning of September next, at Paris, the following topics will be considered:—Report of the Secretary on the work of the Committee since the Copenhagen meeting; report of MM. Brito Capello, Hildebrandson, and Ley on the observation of Cirrus; Should a third International Congress be convoked? the establishment of stations of the first order on the Congo; discussion of the meteorological *résumés* issued in different countries, and eventual preparation of a more uniform plan; the utility of American meteorological telegrams proposed by Gen. Hazen, and organisation of their distribution in Europe; best means of securing the timely reception of meteorological telegrams; ought barometric heights to be reduced to the pressure under 45° of latitude? Should meteorological hours be reckoned from 1 to 24 in conformity with the resolution of the Washington Conference? Designation of a completely covered sky as to the form of clouds; definition of days of rain and snow; should not a uniform height above the ground be recommended for pluviometers? recent progress in the more exact measurement of snow; international meteorological tables; modification of the rules for administration of the International Meteorological Committee. Communications should be addressed to Mr. R. H. Scott, F.R.S., Meteorological Office, 116, Victoria Street, London, S.W.

IN a communication to the Physical Society of Berlin, on April 24 Herr Kayser read a note concerning his experiments on the condensation of gases on surfaces, and Bunsen's criticisms thereon. In a paper published last year Bunsen had declared that the previous results under this head were erroneous, inasmuch as the observers had proceeded upon the false assumption that a maximum of condensation was attained in a few hours or days, Bunsen himself finding that the condensation might go on slowly for years. Herr Kayser, however, had, in reply, pointed out that Bunsen had not been sufficiently careful in cleaning the glass surfaces on which his experiments were made, and he now had the satisfaction to announce that Bunsen, after repeating his experiments with the necessary precautions, had arrived at the same conclusion as himself, namely, that there was no demonstrably slow condensation, but that the maximum of condensation was reached with extraordinary rapidity.

THE project to build a "Grassi-Museum" has now assumed a tangible shape at Leipzig, inasmuch as the site for the new museum has been chosen. The new museum is to contain the collections belonging to the Ethnographical Society, which are now crammed into premises entirely unsuitable for them.

DR. OTTO ZACHARIAS has recently made interesting researches concerning the freshwater fauna of the Silesian Riesengebirge and the county of Glatz. The Royal Prussian Academy of Sciences has just granted him a sum of money towards the continuance of his labours.

MR. HOWARD NEWTON, assistant municipal engineer, of Singapore, has published a series of notes and experiments on the different kinds of timber in ordinary use in the Straits Settlements. The pamphlet contains observations on the forests adjoining our colonies in the Malay Peninsula, and the need already of conservation. The trees are felled in large numbers for ordinary use, and the jungles are cleared and exhausted by the Chinese gambier and pepper planters. Twenty specimens of woods are then described in detail, and finally an account of the mode in which the experiments were conducted and elaborate tables of the results follow. The breaking weights of some of the timbers tested were as follow:—1850, 1836, 1656, 1374, 1286, and 1284 lbs. Notes on the toughness, fracture, deflection, &c., are also given. It is curious to notice that some of the finest trees near Singapore (in the Johore forests) have no botanical equivalents. Mr. Newton specially mentions a tree called by the Malays the *ballow*, which grows from 60 to 100 feet in height, with a diameter of 3 to 6 feet. It is a close-grained, tenacious, hard, heavy wood, very valuable for building. It is called popularly Johore teak, although it does not belong to the natural order *Verbenaceæ*.

THE Russian Geographical Society has awarded a gold medal to M. Klossowski for his work on thunderstorms in Russia. We take the following from M. Rykatcher's analysis of this remarkable work. The initiative of thunderstorm observations having been taken by the Geographical Society in 1871, no less than 1821 regular observations were made during the years 1873 to 1882 at 176 different stations. For 145 of them annual and monthly averages were calculated, and gave the following interesting results. The minimum of thunderstorms (5 to 7 per year) is found in the north; their number increases towards the Gulf of Finland (with a depression south of it) and on the middle Volga, where it reaches 12 to 15 per year, and remains nearly the same throughout middle and southern Russia, with a slight decrease in the Crimea. A rapid increase in the number of thunderstorms is found in Western Russia, especially in Bessarabia (33 at Kishineff), as also in the East, at Tamboff, Penza, and on the Lower Don. The maximum of thunderstorms, 41 per year, is found at Tiflis. As might be expected, the thunderstorms are more frequent where the summer rains and the relative humidity are the greatest. Their diurnal maximum is between

3 and 6 p.m., and the minimum between 3 and 6 a.m. Availing himself of the synoptical maps of Hofmeyer for 1874 to 1876, the author compares, day after day, the thunderstorms with the cyclones which reach Russia, and he arrives at the important conclusion that thunderstorms in Russia—without exception—accompany cyclones, their appearance being influenced at the same time by the local state of temperature and humidity. Marié-Davy, Mohn, and others subdivided thunderstorms into cyclonic and local ones, and the continental ones were reckoned to the second category; but M. Klossowski shows that even in so continental a climate as that of Russia, thunderstorms depend also directly on cyclones. They appear on the borders of the cyclones and mostly in their south-eastern quarters. By further researches, the author arrived at the conclusion that thunderstorms in Russia are secondary or tertiary cyclones appearing on the borders of a cyclone, and thus explains the oscillations of the barometer during thunderstorms, already noticed by Messrs. Scott, Mascart, and others. Hail is obviously closely connected with thunderstorms. It also accompanies cyclones and is always concentrated in its south-eastern quarter, in the zone of 750 to 760 millimetres' pressure. On the whole, the work of M. Klossowski is a valuable contribution to the study of electrical energy in the atmosphere.

IN a lecture delivered in the Institute of the Khedive at Cairo, Dr. G. Schweinfurth has given some account of the seats of manufacture of prehistoric stone implements in the desert of Eastern Egypt discovered by him in 1876 and 1877, and again visited and examined by him in his last journey. The two spots referred to are in the Wadi Sanur and Wadi Warag. The former lies due east of Beni Suef at a distance of thirty miles from that town; the latter is in the upper portion of the Wadi at the place where this water-course begins to be discernible as a longitudinal depression on the heights of the western part of northern Galala. Dr. Schweinfurth's belief that the two sites in question are really those of ancient manufactories of stone implements is grounded partly on the presence of accumulations of cores in the beds of the streams, partly on the fact that the raw material is found abundantly in the neighbourhood. The source of the raw material is a bed of flints belonging to the upper nummulitic limestone corresponding to that which exists behind Cairo. Implements and utensils indicating a stone period have now, Dr. Schweinfurth remarks, been found even in the very heart of Africa, and these show a surprising resemblance in form to those discovered in Europe. Those recently obtained by himself from Sanur and Warag, however, are of a special type, and Dr. Schweinfurth regards them as clearly distinguished from the forms already familiar by the fact that the facets are usually only upon one side and are very seldom seen surrounding the entire core.

IN connection with the trial of Pel for poisoning, which has just resulted in Paris in the condemnation of the accused, some interesting experiments were conducted at the Morgue with a view to testing whether it was possible, as alleged by the prosecution, that the murderer could have got rid of the body of one of his victims by burning it piece by piece in a common stove. The professional witnesses stated that they procured a body weighing sixty kilogrammes. They removed from it forty kilogrammes of organic matter, and lighted a fire of wooden logs. They thus ascertained that in an hour the complete reduction to ashes of one kilogramme of organic matter could be effected, and in forty hours the complete combustion of a body weighing sixty kilogrammes could be completed. The accompanying smell was not disagreeable. The bearing of this on the question of cremation is obvious. It is possible to consume the human body by fire at a comparatively small expense, as these experiments show. In Japan, where cremation has been practised for ages, the quantity of wood consumed in the cheapest cremation is so small that European doctors doubted the evidence of eye-witnesses. Cremation of the lowest class costs only two shillings, on account of the small quantity of wood used, and the operation generally lasts from six to nine hours. The smell for a considerable distance around the crematorium is, however, of a very offensive kind, and the accessories are, as a rule, far from agreeable. There is, however, no doubt that the body can be consumed at a far less expenditure of fuel than is generally considered possible.

THE following appears in the *Times*:—Last autumn, a bookseller named Meyer, of Ronneburg, tied a water-proof label under the wing of a swallow which had occupied a nest at his house, and had become comparatively familiar. On it he wrote a query in German to the effect that he wished to know where the swallow would pass the winter. The bird returned to its former nest bearing an exchange label similarly fastened, saying, in German also, "in Florence, at Castellari's house, and I bear many salutations."

THE Austrian Government has refused to authorise the establishment of private cremation societies, on the ground that they might encourage crime. The decree states that murders are often detected by the exhumation of bodies, and that, even if bodies were to be examined before cremation, there would be no time to apply in every case those delicate chemical tests which are used where poisoning is suspected.

A TELEGRAM from Tiflis states that a severe earthquake has occurred in the Eastern Caucasus. The town of Sikuch is said to have been completely swallowed up. The loss of property is estimated at several million roubles.

THE latest telegrams from India state that the Cashmere earthquakes continue to occur with increased severity. It is reported that 2280 persons have perished in the district of Muzufusabad.

INFORMATION has been received at the Hague from Java that the state of Krakatoa was causing some anxiety. Towards the end of April subterranean sounds were heard in the neighbourhood day after day, and flames arose from the crater. The rocks which emerged from the sea during the last eruption suddenly disappeared.

FROM a report of Mr. H. Walker, Commissioner of Lands of British North Borneo, it appears that gold exists in considerable quantities in that territory. Some natives had brought a little to Sandakan, and Mr. Walker set out to verify its existence in the Sagama district. He searched thirty or forty different places and found gold at almost every place, generally in small distinct specks, large enough to be gathered with the fingers, sometimes larger, and always in conjunction with a black metallic dust and iron or copper pyrites. The rocks met with were granite, gneiss, quartz, limestone, jasper, porphyries, red sandstone. Steps will probably be taken to have the whole region thoroughly examined by a competent geologist. The minerals already ascertained to exist in North Borneo are gold, silver, copper, chromium, tin, plumbago, lead, and coal. Antimony and cinnabar are reported. On the west coast chromium, copper, and arsenic have been found; in the neighbourhood of Kinabalu silver ore and pyrites; a sample of native copper has been sent to London; a rich sample of galena and silver, yielding on assay 115 ounces of silver to the ton, has been found. Hitherto the officials of the Company and the other Europeans on the coast have been dependent for local information respecting these and other minerals on the rough statements of natives. It appears certain, however, that, besides its great forest and agricultural wealth, British North Borneo is also rich in minerals—how-cannot be said until a thorough examination by an expert has been made.

According to the *San Francisco* [illegible] the great [illegible] of Alaska is moving at the rate of a quarter [illegible] per annum. The front presents a [illegible] its breadth varies from [illegible] miles [illegible]. Almost every quarter of an hour hundreds of tons of ice in large blocks fall into the sea, which they [illegible] in the most violent manner. The waves are [illegible] the largest vessels which approach [illegible] oars. [illegible] The top is very rough and broken, [illegible] chains of mountains in miniature. [illegible] advances [illegible] towards the sea.

[illegible]

[illegible]

ASTRONOMICAL [illegible]

[illegible] Prof. Galle [illegible] orbits [illegible] comets [illegible]

before 1860, which have been more definitively determined during the past twenty years, with a few orbits of ancient comets computed for the first time or founded upon better data, including those observed by Toscanelli; in a second table are contained the most reliable orbits of all comets discovered since the year 1800. The elements are given in an approximate form only, but in the notes accompanying each table reference is made to the place of original publication. Prof. Galle's *résumé* will be of much service to the student in this branch of astronomy. It appears to have been drawn up on the suggestion of Prof. [illegible], seeing that there was no immediate intention of publishing a third edition of Olbers's celebrated treatise. Five newly-detected comets of short period figure in the second table.

Binary Stars.—The following calculated angles and distances of several of the more rapidly revolving double-stars will serve to [illegible] measures made about the present time [illegible] by the best available orbits:—

| Star | Epoch | Pos. | Dist. | Authority for orbit |
|---|---|---|---|---|
| [illegible] | 1885·[illegible] | 62·0 | 0·93 | Seeliger |
| | 1886·[illegible] | 57·0 | 0·95 | |
| [illegible] | 1885·5 | 17[illegible] | 0·61 | Doberck |
| | 1886·5 | 182·2 | 0·65 | |
| [illegible] | 1885·5 | [illegible]0·3 | 1·49 | Doberck |
| | 1886·5 | 35·3 | 1·50 | |
| [illegible] | 1885·5 | 285·0 | 0·80 | Doberck |
| | 1886·5 | 210·5 | 0·76 | |

[illegible] (Burnham 151) gives for 1885·6, [illegible]

[illegible] 1572.—Some years since it was shown by [illegible] was observed by Lindauer at [illegible] November 7, 1572, and it is equally certain that [illegible] by Maurolycus at Messina at its meridian transit on the following evening, though there appears to be some confusion between [illegible] and [illegible] in his published de[illegible] was not seen by Tycho until November 11.

[illegible] Scina, in a work printed at Palermo, en[illegible] Maurolico," referred to his observation of this star, apparently given in the first instance in a [illegible] written by Maurolycus (*Judicium de nova stella*), [illegible] in his Bibliography, and subsequently [illegible] written by his nephew. According [illegible] Maurolycus thus records his first observation [illegible] stellam in hoc Messanæ horizonte [illegible] existentem circa tertiam noctis horam [illegible] Unde conjecturam feci eam [illegible] circuli arctici, ut distet hic a meo [illegible] ab æquatore per gradus 66½ [illegible] habet gradus 38½, et eam sitam [illegible] æquinoctiorum secat arcticum circulum, [illegible].

[illegible] Argelander the place of the star for 1573·0 was [illegible] declination 61° 46′·4; the [illegible] at Messina on November 8 was [illegible] and consequently the star was on the meridian [illegible] mean time, or at 8h. 24m. 46s. apparent time, [illegible] after sunset, and the latitude of Messina being 38° 11′, [illegible] 25, which was the distance from [illegible] given by Maurolycus. Nevertheless the Abbé Scina [illegible] agree with [illegible] suggestion that there was a typo[illegible] in Clavius, and that 61½° should be substituted [illegible]. The only alternative, however, would point to an [illegible] in the observation (or estimation), and Scina [illegible] Maurolycus at this time that he was "très-avancé en [illegible] alors 78 ans) depourvu d'instrumens, accablé d'in[illegible]." [illegible] Zach sought unsuccessfully for the special work [illegible] Maurolycus, as well as for his "Life" by his nephew; [illegible] gives no particulars of the former, and hence recourse [illegible] had to Clavius, who, as stated above, made some extracts from the *Judicium*.

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, JUNE 21-27

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on June* 21

Sun rises, 3h. 45m.; souths, 12h. 1m. 30·5s.; sets, 20h. 18m.; decl. on meridian, 23° 27′ N.: Sidereal Time at Sunset, 14h. 19m.

Moon (Full on June 27, 11h.) rises, 14h. 14m.; souths, 19h. 44m.; sets, 1h. 5m.*; decl. on meridian, 8° 24′ S.

| Planet | Rises h. m. | Souths h. m. | Sets h. m. | Decl. on meridian ° ′ |
|---|---|---|---|---|
| Mercury | 3 12 | 11 29 | 19 46 | 23 33 N. |
| Venus | 4 38 | 12 58 | 21 18 | 23 51 N. |
| Mars | 2 4 | 10 0 | 17 56 | 20 26 N. |
| Jupiter | 9 6 | 16 13 | 23 20 | 12 9 N. |
| Saturn | 3 43 | 11 52 | 20 2 | 22 30 N. |

* Indicates that the setting is that of the following day.

*Phenomena of Jupiter's Satellites*

| June | h. m. | | June | h. m. | |
|---|---|---|---|---|---|
| 21 | 21 9 | I. occ. disap. | 25 | 22 30 | III. ecl. reap. |
| 22 | 20 47 | I. tr. egr. | 27 | 20 23 | I. tr. ing. |

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich

| June | h. | |
|---|---|---|
| 21 | — | Sun at greatest declination north; longest day in northern latitude. |
| 24 | 8 | Mercury at least distance from the Sun. |
| 26 | 20 | Venus at least distance from the Sun. |
| 27 | 15 | Mercury in superior conjunction with the Sun. |

## GEOGRAPHICAL NOTES

THE last issue of the *Isvestia* of the Russian Geographical Society (xx., 6) contains an interesting paper, by M. Kosyakoff, topographer, who accompanied, in 1882, Dr. Regel during his journey through Karategin and Darvaz. The paper deals almost exclusively with the topography of the explored region, and thus gives a plain description of the explored routes, containing the necessary topographical data for forming an opinion on the much-debated questions as to the orography of that part of the Pamir region. A route-map, on the scale of ten miles to an inch, accompanies the paper. Starting from Penjkent, M. Kosyakoff soon reached the 9800 feet high lake, Kouli-kalam. Then he crossed the 12,000 feet high and snow-covered Badkhana Mountains which separate the Zarafshan from the upper Surkhab, tributary of the Fan, and continuing to make his way amidst deep and rocky mountain-gorges, he soon reached the lake, Iskander-kul, 7120 feet above the sea-level. Thence, crossing the Mura Pass, richly clothed with vegetation on its northern slope, the expedition descended to Karatag and Hissar, and, by a route quite suitable for carriages, they proceeded further to Kabadian. A good route along the Waksh River brought Dr. Regel and his travelling companions to Kurgantube; but, to reach Koulab, they had to cross the Tash-robat Pass, all covered from top to foot with pistach trees. From Kulab, which is more animated than Kabadian, the expedition went to the rich Mumin-abad Valley, peopled with Tadjiks agriculturists; thence to the twenty-five villages of the Dara district, and, continuing their journey north-east on the right bank of the Pendj, they soon reached Kala-i-khumb. The Pendj River being there but thirty-five miles distant from Tavil-dara on the Waksh, the expedition went there before proceeding further up the Pendj, and followed the upper Waksh in a north east direction for some fifty-five miles. From Kala-i-khumb, M. Kosyakoff made a further very interesting excursion up the Pendj and its tributary, the Vantch, up to its source, whence he was compelled by a fever to return to Kala-i-khumb and thence to Samarcand. The map published by the *Isvestia* contains, moreover, the very interesting route from Tavil dara to Bal-juan, and thence to Hissar, and further west to Baisoun, Anar-bulak, and Yar tube.

AMONG the works announced for this year by the Russian Geographical Society we see the last fascicule of the valuable "Geographical and Statistical Dictionary of Russia;" the atlas of maps to accompany Baron Kaulbars' work on the delta of the Amu-Daria; a geognostic map of the shores of Lake Baikal, by M. Chersky; the work of Dr. Sperck on the Amur region; and a work by M. de Vollan on the songs of Ugrian Russians. There is promised, also, the long-expected results of the great survey of Siberia, from the Ural Mountains to Lake Baikal, accomplished in 1874. The commander of the expedition having died since, the work had to be given for calculations to other persons; but now the name of M. Tillo, who has undertaken its publication, is a guarantee that this capital work will not be lost to science.

DR. FISCHER, of the University of Marburg, the author of a monograph on the climate of Mediterranean countries, read a paper before a recent meeting of the Verein für Erdkunde at Halle on the morphology of the coasts of the Mediterranean, which is reprinted in the *Hallische Zeitung*. "The Mediterranean," he said, "was specially important for some investigations into physical geography, for it has been the theatre of a long history, and we have therefore information about its coasts extending over many centuries. Although it washes the shores of three continents, this sea exhibits a striking similarity in its *fauna* and *flora* everywhere. It must, therefore, in its present form, belong to one of the most recent geological periods, even though particular basins may be much older. It owes its origin to great movements in the crust of the earth, and the form of its coasts is attributable to the same cause, modified by more recent influences. In the present coast formation in the north-western basin, two different types are perceptible, which may most conveniently be designated as the North Sicilian and the Languedoc types. If we follow the coast of Italy from Naples, then the Sicilian and North African coasts around to the Straits of Gibraltar, we meet with twenty-two smaller bays having the form of a semicircle. Their sizes do not vary greatly, the chord of the smallest being 15 km., that of the largest 65, and that of the great majority between 30 and 35 kms. Over this extent the coasts are almost everywhere precipitous, and a short distance from the shore the sea deepens rapidly. How has this formation arisen?" Quoting Suess's "Das Antlitz der Erde," Dr. Fischer said, "there appeared to be all along this coast a great fissure in the crust of the earth. The formation of the Appennines, the Atlas and the occurrence of volcanic phenomena along the whole line would point to this. But this would not account for the bays here mentioned; many of these are probably due to the sea washing away the softer from amongst the harder rocks. The projecting headlands are hard, old, crystalline rocks, while inside are the newer and softer kinds. These inlets, too, are not found everywhere along the coast, but only where the harder rocks are present. That the coasts here are greatly exposed to denudation by the action of the waves is shown by the numerous caves and cliffs, and the violent surge which beats against the vast harbour-works of the French on the coast of Algeria. The prevailing winds there are north and north-east, and thus assist the waves. Another factor is the current, which flows eastwards along the north coast of Africa from the Straits of Gibraltar. This meets the projecting capes and headlands, which deflect part of it into the bays, creating in the latter a counter-current which acts as a scour, keeping the bottom free from alluvium, and also exercising its influence on the semi-circular formation of the inlets. The Bay of Tunis is an exception. This is much deeper than the others, and the currents cannot therefore exercise the same influence over it. The alluvium is deposited, the River Medjerda brings down its contribution, and the result is a constant formation of land there. This bay belongs rather, on this account, to the second type, existing on the Mediterranean coasts of Northern Italy and Languedoc. The Tuscan coast was originally similar to that of Lower Italy, but it has now been altered beyond recognition. Here, to the west of the Appennines there is a wide district with easily-denuded rocks. The rivers, especially since man has so disafforested the region, bring down vast quantities of alluvium. The current which flows into the Tyrrhenian Sea is deflected northward along the coast, and causes the deposit of the alluvium in-shore, so that the ancient bays are gradually silting up. In ancient times the shores of this now harbourless sea had numerous bays, and Tyrrhenians were skilful navigators. At the mouth of the Arno the operation is best seen. Pisa, which was founded as the port on the sea at the mouth of the river, was no longer on the coast in Strabo's time, and is now some distance inland. The land-formation on the coasts of Languedoc is even more striking. In former times there were steep shores, protected by a row of islands, behind which lay a calm inland sea, on which the city of Narbonne was built. The sea silted up from inside and out—from inside by the rivers, from outside by the currents created by the frequent south-east winds which conveyed the alluvium of the eastern rivers, especially the Rhone, and deposited it there. The islands became joined to the land, and the inland sea disappeared. Thus arose on these coasts the flat plains, behind which are small lakes and [illegible]

AT the meeting of the Paris Geographical Society of May 22 further information was read respecting the expedition of M. Teisserenc de Bort to explore the Sahara. Leaving Tuggurt, they marched south-south-west to Hassi Oaled Milond, the last point visited by the Flatters mission. Thence, passing through Bereçoff, they ultimately reached Gabes. Near Ghourd-Rou ned M. de Bort found well-marked traces of an old lake of sweet water, about a kilometre long, and 700 or 800 m. wide. In the depression thus created there were evidences of a prehistoric station in numerous flint arrow-heads, and from this point to Gabes the presence of man at a very ancient epoch was attested by chipped flints.—M. de Quatrefages read a paper on the Red Indians, and on the half-breeds of the United States and Canada. The position which the writer maintains is that the Indians do not diminish so rapidly as is generally believed, as, for example, the Maoris. The half-castes are put in the census as whites; Indian women married to whites are similarly counted. "Placed in favourable conditions, the Redskins, far from diminishing in number, have increased, and are increasing. But they have not preserved their ethnic purity. Mixture with white blood has taken place even in the most remote tribes, and perhaps now the number of natives of pure blood is insignificant everywhere; but, on the other hand, the blood of the natives is mixing more and more with that of the whites, and the latter accept more easily day by day the half-breed as one of themselves." Although the Red Indians are disappearing as such, they will still live in the future true Anglo-American race. M. Henri Condreau gave a succinct account of six journeys which he made between 1881 and 1885 in Guiana. The writer is Professor at the Lycée at Cayenne, and performed two of these journeys during vacations; the others were undertaken at the request of the Governor of French Guiana. The most important one was from Manaos through the whole of Central Guiana, between the Rio Negro and Cayenne. He had already performed two-thirds of his task, and passed the sources of the Trombette, when he lost all his articles for barter amongst the Indians, and was deserted by his followers. During four months he was alone amongst savages, ultimately arriving at his destination by a forced march of thirty days through the virgin forest.

BEFORE the Society of Commercial Geography in Paris, M. Andreau described the prairies of Guiana which he traversed in his journey between the Rio Negro and Cayenne. Behind the enormous forests which extend inland from the coasts he found prairies wholly devoid of trees, where the air was dry and the climate mild. He strongly advocated the establishment of agricultural colonies there, describing the climate as in all respects the reverse of that found on the coast.

THE well-known African traveller, Major Serpa Pinto, is stated to have discovered large coal-fields south of the Rovuma River. The Rovuma is a coast river, and its estuary is situated about 11° S. lat. Along its banks runs the ancient caravan route from Cape Delgado to Lake Nyassa. The coal-fields were first claimed by the Sultan of Zanzibar, but have now been taken possession of by the Portuguese Government.

A SCIENTIFIC expedition under the charge of Lieut. Hovgaard, of the Danish Navy, is being prepared to investigate the eastern coasts of Greenland. M. Gamel, the owner of the vessel, has put it at M. Hovgaard's disposal, and the Danish Government will pay the cost of the expedition.

M. HANSEN-BLANGSTED has reported to the Geographical Society of Paris that the first steamer coming directly from the open sea arrived at Cologne on March 18. It is called the *Industry*, belongs to a company of Mannheim, and is of 513 tons burden. "This is an event important not only for Cologne, but also for every town on the Rhine."

PROF. KARL GOTTSCHE, of the University of Kiel, has just returned from his travels in Eastern Asia. After having lectured on Mineralogy and Geology for several years at Tokio, he undertook a scientific exploring expedition in Korea, at the request of the Korean Government, which lasted until December, 1884. His route extended over 3000 kilometres. Dr. Gottsche intends shortly to publish his geological, mineralogical, and ethnographical investigations of Korea. To our knowledge this is the first scientific investigation of the great East-Asiatic peninsula.

DR. H. Z. C. TEN KATE departed on May 18 from Southampton. He goes to the interior of Surinam, where he intends to devote himself to anthropological and ethnological studies. A grant has been given to him by Dr. Riebeck (Halle a/S) and Prince Roland Bonaparte.

A TELEGRAM dated "near Herat, June 9," states that, pending the settlement of the frontier question, the Frontier Commission is exploring and mapping out the country in all directions.

## *ON THE MESOZOIC FLORAS OF THE ROCKY MOUNTAIN REGION OF CANADA*[1]

IN a previous memoir, published in the *Transactions* of the Royal Society of Canada, vol. i., the author had noticed a lower cretaceous flora consisting wholly of pines and cycads occurring in the Queen Charlotte Islands, and had described a dicotyledonous flora of Middle Cretaceous age from the country adjacent to the Peace River, and also the rich Upper Cretaceous flora of the coal formation of Vancouver's Island—comparing these with the flora of the Laramie series of the North-West Territory, which he believed to constitute a transition group connecting the Upper Cretaceous with the Eocene Tertiary.

The present paper referred more particularly to a remarkable Jurasso-Cretaceous flora recently discovered by Dr. G. M. Dawson in the Rocky Mountains, and to intermediate groups of plants between this and the Middle Cretaceous, serving to extend greatly our knowledge of the Lower Cretaceous flora and to render more complete the series of plants between this and the Laramie.

The oldest of these floras is found in beds which it is proposed to call the Kootanie group, from a tribe of Indians of that name who hunted over that part of the Rocky Mountains between the 49th and 52nd parallels. Plants of this age have been found on the branches of the Old Man River, on the Martin Creek, at Coal Creek, and at one locality far to the north-west on the Suskwa River. The containing rocks are sandstones, shales, and conglomerates, with seams of coal, in some places anthracitic. They may be traced for 140 miles in a north and south direction and form troughs included in the Palæozoic formations of the mountains. The plants found are conifers, cycads, and ferns, the cycads being especially abundant and belonging to the genera Dioonites, Zamites, Podozamites, and Anomozamites. Some of these cycadaceous plants, as well as of the conifers, are identical with species described by Heer from the Jurassic of Siberia, while others occur in the Lower Cretaceous of Greenland. The almost world-wide *Podozamites lanceolatus* is very characteristic, and there are leaves of *Salisburya sibirica*, a Siberian Mesozoic species, and branches of *Sequoia smittiana*, a species characteristic of the Lower Cretaceous of Greenland. No dicotyledonous leaves have been found in these beds, whose plants connect in a remarkable way the extinct floras of Asia and America and those of the Jurassic and Cretaceous periods.

Above these are beds which, with some of the previous species, contain a few dicotyledonous leaves, which may be provisionally referred to the genera *Sterculia* and *Laurus*; and still higher the formation abounds in remains of dicotyledonous plants, of which additional collections have been made by Mr. T. C. Weston. The beds containing these, though probably divisible into two groups, may be named the Mill Creek series, and are approximately on the horizon of the Dakota group of the United States geologists, as illustrated by Lesquereux and others. The species are described in the paper, and differ for the most part from those of the Dunvegan group of the Peace River series, which is probably of the age of the Niobrara group, and, of course, still more from the overlying Laramie group. With regard to the latter, the author adduced some new facts confirmatory of his previously expressed view as to the position of the Laramie at the top of the Cretaceous and base of the Eocene, and also tending to show that some of the plants still held by certain palæo-botanists to be of Miocene age are really, in Canada at least, fossils of the Laramie group, and consequently considerably older than is currently supposed. The collections of plants studied by the author had for the most part been placed at his disposal by the Director of the Geological Survey.

## *HYDROMECHANICS*

THE last of the series of lectures at the Institution of Civil Engineers during the session of 1884-85 on "The Theory and Practice of Hydromechanics," was delivered on Thursday

[1] Read before the Royal Society of Canada, May, 1885, by Sir William Dawson, C.M.G., LL.D., F.R.S.

evening, May 7, by Sir Edward Reed, K.C.B., M.P., on "The Forms of Ships." The President, Sir Frederick Bramwell, F.R.S., occupied the chair.

In the course of his address the Lecturer briefly explained the great development which the science of fluid resistance had undergone of late years, largely owing to the labours of Stokes, Rankine and others, but more largely still to those admirable investigations which had been carried out under the patronage of the Admiralty by the late Dr. William Froude, and subsequently by his son, Mr. R. E. Froude. He likewise explained the very great effect which those investigations had produced in the Royal Navy, owing to the judicious and prompt adoption of Froude's results by the Admiralty Constructors. Stress was laid throughout the lecture upon the importance of adjusting the form and proportions of ships not only to the loads which they have to carry, but likewise to the weight of the materials entering into their structure. It was a common error to judge of the merits of steamships by the relations which exist between their displacement, steam power, and speed, as expressed by formulæ of various kinds. Approximations to the theoretical form of least resistance were sought by some naval designers, and all considerable departures from that form were regarded as objectionable. The Lecturer, on the contrary, pointed out that no such theoretical form was any true or proper guide for a naval designer, since every change in the average weight of the hull necessitated a corresponding change in the form and proportions of the ship, and the great merit of a designer often was that he adopted forms differing widely from the abstract forms of the schools, and presenting a very inferior appearance when put into what are known as "Constants of Performance." This was illustrated by examples derived partly from actual ships and partly from calculations made for the purpose. Two actual warships were compared, one attaining the high figure of 213 marks when examined by the received formulæ, and the other gaining but 172 marks; yet in the Lecturer's view the latter was far and away the better ship, because she performed precisely the same service as the other, being inferior in no respect, and yet had cost less than the other by £114,000, and expended no more steam-power in attaining an equal speed. The Lecturer remarked that he should probably have regarded the abstract "form of least resistance" with more respect but for the circumstance that the designing of armoured vessels in which he was much engaged is "a branch of naval construction of much too concrete and ponderous a character to admit of any dalliance with abstract or fancy forms." He went on to express his regret that, owing largely to the restrictions which granite docks imposed upon naval constructors, and to the absence of iron floating docks capable of receiving ships of any form, and owing to other causes likewise, the construction of armoured ships—by which he meant ships which had a sufficient volume protected above the water to keep them afloat and upright while the armour remained intact—had been abandoned, and the first place upon the sea had been offered to any nation which had the courage and the will to assume it. In his opinion this was a purely voluntary abandonment, and was not the result of any scientific or economic necessity. He admitted that great changes in forms and proportions were very desirable in our great line-of-battle ships; for example, a great increase of breadth was necessary in order to economise the side armour, and to keep the ram and torpedo at ample distance from the boilers and magazines, which should be protected by an inner citadel, so to speak, well removed from the outer one. But so far was true science from presenting obstacles to these and other important changes, it actually invited these very changes, and increase of beam in particular had been shown by Froude to facilitate the attainment of practical invulnerability combined with very high speed. Size and cost were among the bugbears of our naval administration; by the true engineer they were always regarded as secondary to great and noble objects, among which objects he included the naval pre-eminence of our country. At any rate, there was no engineering obstacle whatever to England constructing and sending to sea, not merely those great and swift but delicate and fragile Atlantic hotels in which the British Navy is now to embark and fight, for the want of something better, but also war-ships—real war-ships—almost as invulnerable as these islands themselves, and capable of bearing the once-proud flag of England boldly into the waters of any enemy whatever.

On the motion of the President, a cordial vote of thanks was passed to Sir Edward Reed for his interesting and instructive lecture.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE*

CAMBRIDGE.—In the second part of the Natural Science Tripos the examiners have placed the following in the first class in alphabetical order:—Men: Acton (Botany), St. John's; Eve, B.A. (Physics), Pembroke; Fitzpatrick (Physics), Christ's; Gordon (Physiology), Trinity; Shore (Physiology), St. John's; F. M. Young, B.A. (Physics), Trinity.

The Senior Wrangler, Mr. Berry, of King's College, was a student at University College School and College; the Second Wrangler, Mr. Love, of St. John's, was educated at Wolverhampton Grammar School. The Wranglers, thirty-four in number, are alone eligible to compete in the third part of the Mathematical Tripos a year hence.

In the Natural Sciences Tripos, Part 1, the following were placed in the first class, in alphabetical order:—Men: Bury, Trinity; Couldridge, Emmanuel; Edgeworth, Caius; Evans, F. P., St. John's; Oliver, F. W., Trinity; Rolleston, St. John's; Seward, St. John's; Walters, H. G., Trinity. Women: Freund, J., Girton; Willoughby, C. A. J., Newnham.

The University Lectureship in Mathematics, lately held by Prof. J. J. Thomson, will be filled up by the General Board of Studies and the Special Board for Mathematics early in the Michaelmas Term.

It is proposed, in dealing with the increased income of the Craven Fund, to establish a new Studentship of 200*l.* a year for research in the Languages and History of Ancient Greece and Rome and the Comparative Philology of the Indo-European Languages; the Studentship to be tenable for one year, but a student might be re-elected on not more than two occasions.

It is proposed still further to systematise and improve the courses of local lectures in populous centres, and to give students University certificates and exemptions in all cases where satisfactory work has been done, instead of confining these special privileges to affiliated Colleges. The majority of the courses given in the past winter have been scientific, and the work continues to extend, under the energetic administration of Dr. R. D. Roberts. Much difficulty exists in some of the most promising centres, where the students (miners and artisans) are poor, in providing funds. There ought to be no difficulty in persuading colliery proprietors and manufacturers to find the money needed.

## *SCIENTIFIC SERIALS*

*Bulletins de la Société d'Anthropologie de Paris*, 5me Fascicule, 1884.—On ancient superstitions still surviving among the Bretons, by M. Bonnemère. An interesting paper, showing among many other proofs of superstition that the peasantry believe in the possession by certain individuals, whom they characterise as "Ribotteurs," of the power of injuring others by causing their milch cows to lose their milk. The so-called "Ribotteurs" are believed to acquire this power by roaming naked through the fields on the night of April 30 to gather, at early dawn, the May dew, in which dwells the malevolent property of drying up the milk of cows.—On the uni-discoidal placenta of a mandril, by M. Chudzinski.—On the degree of atrophy of the olfactory nerves compatible with the persistence of the sense of smell, by M. Mathias Duval. The writer draws attention to the number of cases in which a post-mortem examination has proved the atrophy, or even total absence, of olfactory nerves, although there had been no apparent defect in the sense of smell during life. M. Dally is of opinion that in such cases an excess of the gray matter of the brain at any one point may serve to supplement a deficiency in some other cerebral region.—M. Topinard presented to the Society a copy of his great chart of the relative heights, registered among the conscripts and in the public schools of different parts of France.—Report of proceedings at the first meeting of the "Conférence Transformiste," organised last year in memory of Darwin. In accordance with the scheme of the Conference an address was to be annually delivered by a member of the Anthropological Society of Paris, who was to indicate the influence which Darwinian ("Transformist") views had had on the special branch of scientific inquiry which the lecturer prosecuted.—This year's address in the Physical Section of the Conference was delivered by M. Duval, who chose for his theme the evolution of the eye from the early development of the visual organs among the lower animals. His treatise is profusely illustrated by admirgrammatic woodcuts.—In the Psychical Section of the Conference M. Letourneau treated of the evolution of morality, tracing the rise and progress and various fluctuations of the moral sense among different races.—M. Pozzi, in announcing the decision of the Committee for awarding the Broca prize, explained that he and his colleagues had selected the works of three among the numerous competitors, viz. MM. Collignon, Chudzinski, and Testut, as of pre-eminent merit. The prize was, however, unanimously awarded to the last-named, M. Testut's great work, "Muscular Anomalies in Man explained by Comparative Anatomy," having secured him this distinction both on account of its able and exhaustive character and its great literary merits. The selected essays of MM. Collignon and Chudzinski, treated respectively of the "anthropometric differences of the leading races of France," and of the "Anatomy of the Negro." In his address M. Pozzi gave a summary of M. Testut's work, of which he spoke in terms of unqualified praise, both as regards the methods with which his observations had been conducted, and the manner in which the results were compared and tested.—Report of the eulogy on Paul Broca, delivered by M. Dally on the day the Broca prize was awarded for the first time. As an old friend and colleague, M. Dally, in his historical and literary notice of the life and works of Broca, was able to give many hitherto unknown particulars, which add largely to the interest of his address.

*Bulletins de la Société d'Anthropologie de Paris*, 1er Fascicule, 1885, containing *résumé* of the rules, organisation, and actual condition of the Society, with lists of members, affiliated societies, and recent obituary, &c., &c., &c. Among the works presented to the Society at its inaugural meeting, 1885, special notice is due to the "Elements of General Anthropology," by M. Topinard, who here gives a *résumé* of his lectures at the School of Anthropologie since 1876; the "Gitaños of Spain and Portugal," by M. Bataillard; "Ethnic Mutilations," by M. Magitot; and "Cannibalism among the Red Skins," by M. Letourneau. In regard to each of these, the authors treated at great length of the objects aimed at in their respective works, the character and scope of which they fully explained.—M. Chudzinski presented the Society with the cast of the deltoid muscle of a negro, showing an anomalous separation of the bundles, which had a Simian character.—M. Delisle drew attention to an ox's head belonging to *Bos indicus* of Senegal, in which a perfectly developed horn protruded from between the nasal bones.—A paper by Dr. Hoffman, of Washington, on a curious relic found in South California, supposed to have been a case for keeping the colouring-matters and instruments employed in tattooing.—On the Quaternary deposits of Rosny (Nogent-sur-Marne), by M. Eck. Among these finds are fine teeth of *Elephas primigenius*, *Rhinoceros tichorhinus*, *Equus*, &c.—Report by M. Gouin, of Cagliari, on the skulls and objects found by M. Issel in the recently-opened cave at Orreri, in the Island of Sardinia. M. Issel believes, from his study of the prehistoric remains of Western France, Spain, and the basin of the Mediterranean generally, that these and the finds at Orreri all point equally to the diffusion of a primitive race, which was extant in the Canary Isles within historic times.—On Laos, by M. P. Neis, who explored the Laotian territory bordering on Cambodia in 1882-84. The author, as a French official, enjoyed exceptional advantages for travelling in Cochin China and the neighbouring districts, and his careful study of the character and habits of the people has enabled him to collect much interesting information regarding the distinctive anthropological and social characteristics of the different races of Indo-China. M. Neis sees no ground for the opinion that these races exhibit traces of a Negrito element, but he draws attention to the fact that everywhere the Mongol is displacing the Thay and other ancient nationalities, although this is most evident in the territories between Mam-on and Tonkin, and he believes that, unless the King of Siam takes prompt measures to stop this invasion, Siamese supremacy and French authority will be alike endangered.—Ceylon and its inhabitants in ancient and modern times, by M. Beauregard. The author derives his materials from English sources.—On the caves of Saumoussay, by M. Bonnemère, who believes that these grottoes served in prehistoric ages as a tannery.—On the measurements of the long-bones as a basis for the reconstruction of the entire skeleton, by M. Topinard, with plates of the osteometric instrument used by Broca.—On will, considered from a physiological point of view, by M. Fauvelle.

## SOCIETIES AND ACADEMIES

### LONDON

**Royal Society**, May 7, with a note added May 12.—"On the Electric Resistance of a New Alloy named Platinoid." By J. T. Bottomley, M.A., F.R.S.E.

In the course of a series of experiments on the electric resistance of various metals and alloys and in particular on the variation of the electric resistance of these metals and alloys with temperature, the author has examined a new alloy (called by the inventor "platinoid"), which has turned out to have important properties.

This alloy is the invention of Mr. F. W. Martino, of Sheffield, who kindly supplied specimens of the metal, and wires specially drawn down to the finer gauges for experiments.

Platinoid is practically German silver with the addition of a small percentage (1 or 2 per cent.) of metallic tungsten. The tungsten is added in the form of phosphide of tungsten, a considerable percentage of which is in the first place fused with a portion of the copper. The nickel is then added; and then the zinc and the remainder of the copper. The mixture requires to be re-fused more than once, and during the process the phosphorus and a considerable portion of the tungsten originally added is removed as scoriæ. In the end there is obtained a beautiful white alloy, which is platinoid. When polished the alloy is scarcely distinguishable in appearance from silver. To test the quality claimed for it as to being untarnishable, the author has been keeping ornamental specimens lying exposed to the ordinary town atmosphere; and has satisfied himself that the alloy has a very remarkable power of resisting the tarnishing influence of the air of a large town.

It is, however, the electric resistance of platinoid that has chiefly interested the author. German silver wire has proved of great use in the construction of galvanometer coils and resistance coils, on account of two important properties, viz., its very high resistance and the smallness of the variation of its resistance with change of temperature. Both those properties are possessed in a still higher degree by platinoid alloy.

The resistance of German silver differs considerably in different specimens. It is commonly stated to be $21{\cdot}17 \times 10^{-6}$ B.A. ohms between opposite faces of a centimetre cube at 0° C.;[1] or, reducing to legal ohms, $20{\cdot}935 \times 10^{-6}$ legal ohms between the opposite faces of a centimetre cube. The following table shows the resistance of a number of specimens of platinoid wire:

| Specifying number | Diameter in decimals of a centimetre | Cross Section | Resistance legal ohms per metre | Resistance between opposite faces of a centimetre cube legal ohms. |
|---|---|---|---|---|
| 16 | ·1610 | ·0204300 | ·181 | $36{\cdot}98 \times 10^{-6}$ |
| 17 | ·1430 | ·0160200 | ·202 | 32·36 |
| 18 | ·1230 | ·0119400 | ·288 | 34·38 |
| 19 | ·1110 | ·0096770 | ·353 | 34·16 |
| 20 | ·0865 | ·0058760 | ·555 | 32·61 |
| A | ·0595 | ·0027180 | 1·250 | $34{\cdot}76 \times 10^{-6}$ |
| B | ·0495 | ·0019240 | 1·707 | 32·85 |
| 28 | ·0402 | ·0012690 | 2·605 | 33·06 |
| 29 | ·0340 | ·0009070 | 3·412 | 30·94 |
| 32 | ·0290 | ·0006605 | 4·371 | 28·87 |
| 36 | ·0220 | ·0003801 | 8·219 | 31·24 |

It appears from these results that the specific resistance of platinoid is about *one and a half* times that of German silver.

The experiments on the variation of resistance of platinoid with temperature were carried on in the following way. The specimen of platinoid to be tested was wound on a wooden bobbin, on the surface of which a screw had been cut, and the spires of the helix were kept separate by lying between the threads of the screw. This coil was immersed in a bath of oil, and was connected in series with a known wire of German silver, the temperature of which was kept constant, and with a single Daniell's cell. The differences of potential between the two ends of the platinoid wire and the two ends of the German silver wire were determined by applying the electrodes of a a high-resistance galvanometer. The ratio of the differences of potential is the same as the ratio of the resistances of the two wires.

[1] Given by Prof. Fleeming Jenkin, F.R.S., as expressing the results of Matthiessen's experiments.

In the following table is shown the ratio of the resistances of a specimen of platinoid wire at different temperatures to its resistance at zero. The wire used was the same as that specified as No. 20 in the table of resistances. The length of the wire experimented on was about four-fifths of a metre. The only trouble in the experiment was the keeping the oil-bath, which was filled with linseed oil, thoroughly stirred, and of uniform temperature throughout.

| Temperature. | Resistance. The Res. at 0° C. being = 1. |
|---|---|
| 0° | 1·0 |
| 10 | 1·0024 |
| 20 | 1·0044 |
| 30 | 1·0075 |
| 40 | 1·0066 |
| 50 | 1·0097 |
| 60 | 1·0126 |
| 70 | 1·0134 |
| 80 | 1·0166 |
| 90 | 1·0188 |
| 100 | 1·0209 |

This gives for the average percentage variation of resistance per 1° C., between the temperatures 0° C. and 100° C., the number 0·02087. A second wire tested very carefully in a similar way gave for this average percentage variation between 0° and 100°, 0·022 per degree, with a steadily increasing rate of variation from the beginning.

To compare this increase in resistance due to increase of temperature with that observed in other metals and alloys, we find that the percentage increase of resistance for 1° C. at 20° C. for copper is 0·388, platinum-silver alloy 0·031, gold silver alloy 0·065, and for German silver 0·044. These numbers were obtained by Matthiessen in the course of his experiments for finding a suitable metal or alloy for the purpose of constructing the British Association standards of electric resistance. It appears that the variation of resistance of platinoid with temperature is very much smaller than the smallest observed for any of the metals and alloys then examined.

The modulus of rigidity, the Young's modulus (or modulus for elastic longitudinal extension), and the breaking weight for platinoid wire were also determined. The wire used was a portion of that marked *A* in the foregoing table. This wire is a little larger than No. 24 of the Board of Trade standard wire gauge, and has a diameter of 0·0595 cm.

The rigidity modulus was found to be 4751·8 × $10^5$ grammes weight per square centimetre. The Young's modulus is 1222·4 × $10^6$ grammes weight per square centimetre.

The breaking weight is about 6·029 × $10^6$ grammes weight per square centimetre.

The specific gravity of platinoid wire has also been found by the author to be 8·78 compared with water at 20° C. Platinoid when drawn hard is softened, like copper, by heating and sudden cooling.

**Physical Society**, May 23.—Prof. Guthrie, President, in the chair.—Dr. A. H. Fison was elected a Member of the Society.—The following communications were read:—Experiments showing the variations caused by magnetisation in the length of iron, steel, and nickel rods, by Mr. Shelford Bidwell. The subject of the extension and retraction of bars of iron and nickel under the action of magnetic force has been investigated by Drs. Joule and A. M. Mayer, and by Mr. Barrett. In the present experiments the magnetising force has been increased, with the result of bringing out some striking and novel characteristics. The apparatus employed consisted of a vertical magnetising helix considerably longer than the experimental rod, the latter forming the central portion of a [illegible] rod, the two ends being of brass. The lower end of [illegible] and stands on a firm support; the upper end [illegible] bears against a brass lever 15 cm. in length [illegible] from the fulcrum; the portion of the rod [illegible] central portion of the helix. The above lever [illegible] another knife-edge at the end [illegible] a second lever, at the extremity of which [illegible]. A lamp and vertical scale being placed at a distance of [illegible] the slightest motion of the mirror could be read [illegible] way, an elongation of the bar, amounting to [illegible] being easily detected. A few of the [illegible] follow:—In the case of soft iron the bar [illegible] length till nearly saturated, up to which point Mr. [illegible] traced it, but then it reached a maximum, decreased, and continued decreasing to the limit of the experiments, at which point the retraction was about double of what the extension had been. The effect depended upon the thickness of the bar, an increase of diameter diminishing the maximum extension, and increasing the critical magnetising force, or that force which produced the maximum extension; the results seemed to show that this extension varied inversely as the square root of the diameter of the bar. The general behaviour of steel was the same as that of soft iron, but the critical point varied with the hardness and temper of the metal, appearing to be a minimum for steel of yellow temper. The results of experiments upon nickel coincided with those obtained by Prof. Barrett, the effect of magnetisation being to cause a continuous retraction greater than that obtained with soft iron. In answer to Prof. Hughes, who believed that the effect of the coil was always to produce *retraction* of the bar, the *extension* at first being due to the molecular arrangement of the particles during magnetisation, Mr. Bidwell further described an experiment showing that the action of the coil was to produce the *extension* of a magnet. Two thin strips of soft iron fastened together at the ends, their central portions being about 2 cm. apart, were placed in the coil. On making the current the ends were drawn out, the sides coming together. Prof. Forbes suggested that the effect of thickness was really owing to the irregularity of magnetisation produced by the ends, and that in future experiments the middle of the bar only should be examined.—On the spectral image produced by a slowly rotating vacuum-tube, by Mr. Shelford Bidwell.—Note on the action of light in diminishing the resistance of selenium, by Mr. Shelford Bidwell. As the result of the investigation upon the behaviour of selenium, Messrs. Adams and Day arrived at the conclusion that it conducted electrolytically. Since this would necessitate the assumption that selenium is not an element according to accepted theories, caution must be exercised in accepting this. It seemed possible, however, that since the selenium in the cells had always undergone a prolonged cooking in contact with the metal terminals, selenides of these metals might exist in the selenium, forming a kind of network, and thus affording conduction through the mass, which, without the cooking, is non-conducting. It had not been possible to test this directly, but a somewhat analogous case had been tried. Some precipitated silver had been heated for some hours with sulphur, and the clear liquid poured off. A cell was then made by [illegible] a strip of mica, the space between the wires being filled with the [illegible] which would contain a [illegible]. It was found necessary to reduce the resistance of the cell by placing a [illegible] and [illegible] again. The cell [illegible] was very [illegible] by heating a piece of [illegible] to one [illegible]. Mr. Clark said that Mr. B[illegible] [illegible] Faraday [illegible] in the [illegible] On the other hand, [illegible] and Ayrton [illegible] metals and were [illegible] the ordinary selenium [illegible] cells. Mr. Clark [illegible] Mr. Bidwell [illegible] of Adams and Ayrton [illegible] by Mr. J. [illegible] Faraday [illegible]

**Mathematical Society**, June 11.—[illegible], F.R.S., President, in the chair.—Prof. J. Larmor was admitted [illegible] into the Society.—Mr. Basset read a paper on the potential of an electrified spherical bowl, and on the motion of an infinite liquid about such a bowl, upon which Prof. Larmor made some remarks.—Mr. Elliott communicated a short paper by M. Z. J. Rogers, entitled, notes on the polism of the inscribed and circumscribing polygon.—Mr. Kempe, F.R.S., made a brief communication on pairs of collinear points; and a paper by Prof. Mannheim, liaison géométrique entre les sphères osculatrices de deux courbes qui ont les mêmes normales principales, was taken as read.

**Chemical Society,** June 4.—Dr. Hugo Muller, F.R.S., President, in the chair.—Mr. Harold Follows was admitted as a Fellow of the Society.—The following paper was read:—On the constitution of the haloid derivatives of naphthalene, by Prof. Meldola.

**Anthropological Institute,** June 9.—Francis Galton, F.R.S., President, in the chair.—Prince Roland Bonaparte exhibited a large collection of photographs of Lapps.—Mr. P. A. Holst exhibited three water-coloured photographs out of a collection of 240, representing all the tribes of the Russian empire.—Dr. J. G. Garson read a paper on the physical characteristics of the Lapps; and by the permission of the authorities of the Alexandra Palace, the family of Lapps now being exhibited there were present in the room with their sleigh, reindeer skins, and dog. The group consists of three men, two women, and two young children. The average height of the men is 5 feet 1½ inches, that of the women 4 feet 11¼ inches. The chief characteristics of the Lapps may be said to be their low stature, round heads, and large cranial capacity.—Prof. Keane read a paper on the Lapps: after glancing at their origin, ethnical relations and nomenclature, explaining the perplexing terms Lapp, Finn, Same, &c., the Professor proceeded to describe their present habitat, their national and political divisions, and population; not more than about 30,000 Lapps remain, and their number appears to be diminishing. Their social usages were then described, and allusion made to their reindeer, dogs, sledges, snow-shoes, and tents, and the paper concluded with an account of their religion, education, present condition, and future prospects.—A paper by Dr. H. Rink on Eskimo dialects was taken as read.

EDINBURGH

**Mathematical Society,** June 12.—Dr. Thomas Muir in the chair.—Prof. Tait gave an address on the detection of amphicheiral knots, with special reference to the mathematical processes involved.

PARIS

**Academy of Sciences,** June 8.—M. Bouley, President, in the chair.—Action of chloroxicarbonic ether on the cyanate of potassium, by MM. Wurtz and Henninger. In an accompanying note it is stated that this important posthumous monograph was mostly prepared in 1875, but that its publication was delayed by the authors in order to complete their researches on various points. After the death of M. Wurtz the work was continued by M. Henniger, who was about to publish the results when he also fell a victim to his arduous labours. In its present form the paper has been prepared and edited by M. Edouard Grimaux.—Memoir on the temperature of the atmosphere and ground at the Paris Natural History Museum during the years 1883 and 1884, by MM. Edmond Becquerel and Henri Becquerel. This memoir forms a continuation of the researches begun twenty-two years ago at the Museum by M. A. C. Becquerel, by means of the thermo-electric apparatus invented by him.—On the geographical distribution of animal and vegetable species as affected by the climatic conditions, the character of the soil, the disposition of land and water, the progress of culture, and other outward influences of the environment, by M. Emile Blanchard.—Propagation of the earthquake shock felt in Andalusia on December 25, 1884, a rectification, by M. F. Fouqué.—On a new order of metallic spectra, by M. Lecoq de Boisbaudran.—Note on a new vegetable type from the lower coralline formations of Auxes, in the neighbourhood of Baune, Côte d'Or, by M. G. de Saporta. This type, by the author named Changarniera, from its first observer, appears to be of lacustrine origin, and to bear a certain relation to the Rhizocaulon from the freshwater chalk-formations of the South of France, still surviving in Provence. It may, perhaps, represent one of those proangiosperm types, the existence of which has only begun to be suspected by botanists.—Note on some recently-discovered documents connected with the infancy of Jean Le Rond d'Alembert, by M. L. Lallemand. These inedited records show that, contrary to Condorcet's statement, d'Alembert was sent to the Maison de la Couche, and placed with a nurse for six weeks in a Picardy village, after which he was consigned to the charge of Jacques Molin (Dumoulin), one of the most distinguished physicians of the time.—On a method of rapidly analysing all the nitrogen contained in substances in the organic, ammoniacal, and nitric state, by M. A. Houzeau.—On a method of employing the sextant in such a way as to obtain by a single observation the simultaneous altitudes or angles of two stars, of a star and the moon, or of a star and the sun, by M. Gruey.—On the convergence of a continuous algebraic fraction, by M. Halphen.—Remarks on the radiations emitted by incandescent carbons, such as those prepared for use in lighthouses for the production of voltaic arcs, by M. Félix Lucas.—Remarks on the apparatus usually employed for the measurement of continuous and other electric currents, by M. Mascart.—A thermo-chemical study of electric accumulators, by M. Tscheltzow.—Note on the action of silver, copper, iron, and some other metals on a mixture of acetylene and air, by M. F. Bellamy. The author's experiments show that in the burner these metals, and especially copper, act on acetylene in the same way that platinum does on hydrogen.—Note on the sulphurets of cerium and lanthane, by M. Debray.—On a new reaction for digitaline, by M. Ph. Lafon. This reaction, which is extremely sensitive, will enable the chemist to distinguish more sharply than has hitherto been possible between the numerous products employed in therapeutics under the general name of digitaline.—Note on aseptol (orthoxiphenylsulphurous acid), by M. E. Serrant. For this substance (so named by the author from the Greek negative particle ἀ and σηπτόν, corruption) it is claimed that it will be found three times superior to phenic acid as a practical antiseptic.—On electric alcoholic fermentation, by M. Em. Bourguelot.—Remarks on the tail of the human embryo, by M. H. Fol. From his researches the author is satisfied that during the fifth and sixth weeks of its development the human embryo is furnished with a tail in the strict anatomical sense of the term. Being destitute of all physiological use, this organ must be classed with all other rudimentary members.—On the natural evolution of the cantharides, by M. H. Beauregard. The results are here embodied of three years' research, during which the author has succeeded in clearing up many obscure points connected with the physiological life and functions of these insects.—Note on the extraction and composition of the gases contained in the leaves of plants, by MM. N. Gréhaut and Peyrou.

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*SATURDAY*, JUNE 27.

ROYAL BOTANIC SOCIETY, at 3.45.

# Messrs. MAC…

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… in the press, may be … "The Types of Greek … al Turning"; Audsley's … kyer's … ectral Analysis"; Burgess's … vey of India"; "Sam…el Palmer: a Memoir."

… ast work the *Athenæum* says:—"This book is admirably illustrated by fourteen autotype reproductions from lovely and characteristic sepia drawings."

Printed by RICHARD CLAY AND SONS, at 7 and 8, Bread Street Hill, Queen Victoria Street, in the City of London, and Published by MACMILLAN AND CO., at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, June 18, 1885.

# NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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

No. 817, Vol. 32] THURSDAY, JUNE 25, 1885 [Price Sixpence

Registered as a Newspaper at the General Post Office]

Fig. 1.—Twelve mathematicians.

Fig. 2.—Sixteen naturalists.

Fig. 3.—Thirty-one academicians.

Fig. 4.—

# COMPOSITE PORTRAITS OF AMERI

THURSDAY, JUNE 25, 1885

## THE CHITTAGONG HILL TRIBES

*The Chittagong Hill Tribes. Results of a Journey in the Year* 1882. By Dr. Emil Riebeck. Translated by Prof. A. H. Keane. (Asher, 1885.)

THE visit paid by Dr. Riebeck to the frontier tribes between Chittagong and Independent Burmah in the spring of the year 1882 formed a mere episode in the great expedition to the Far East, from which he has recently returned, laden with ethnological treasures of all sorts. But this episode, carried out at the suggestion of Dr. Bastian, "prince of ethnologists," proved from a variety of causes so unexpectedly fruitful in results, that he has been well advised to publish a separate account of it, pending the appearance of a comprehensive work on his general travels in Somaliland, India, China, Japan, and other Eastern regions. In its arrangement, profusion of coloured and other illustrations, and especially in the treatment of the subject matter, this first instalment almost reaches the standard of ideal perfection—of such perfection as can be achieved only by patient and intelligent observation, and by the cooperation of specialists in their several faculties combined with a generous use of unlimited means. Certainly the principle of division of labour in literary and scientific work has never been more happily illustrated than in the present instance. Wisely limiting his own functions to those of a laborious collector and narrator of his personal experiences, Dr. Riebeck has placed all his rich materials at the disposal of the foremost naturalists in Germany, by whom the data thus supplied have been made a convenient text for so many separate monographs of great value on the various scientific aspects of the subject.

The work thus comprises, besides the journey itself graphically described by the traveller, four independent treatises—by Dr. A. Grünwedel, on the ethnology; by Dr. Rudolf Virchow, on the anthropology; by Prof. Julius Kühn, on the zoology; and by Herr von Danckelmann, on the meteorology of the hilly region traversed during the expedition.

The trip included altogether two separate excursions, the first from Chittagong up the Karnaphuli river to Pakhoma and Forts Sirtay No. 1 and 2, close to the Burmese frontier; the second, again from Chittagong southwards to the Sangu, up that river nearly to its source, thence across the border to Dalakmey on the Koladan in Arakan, and from that point down the Koladan to its mouth at Akyab. None of these river basins can be described as unknown regions, seeing that they all lie well within British territory, and have been frequently traversed in various directions by Lewin, Hunter, and other explorers, by Government surveyors, and even occasionally by military expeditions. Nevertheless, such is the intricate character of the land, consisting of nearly parallel mountain ranges running close together, mainly north and south, separated by deep intervening river gorges, often densely wooded, and inhabited by a multiplicity of semi-independent hill tribes in almost every stage of social culture, that the broad physical features both of the country and its inhabitants had hitherto been but imperfectly understood, while few of the details had been fully worked out. Hence a rich harvest still awaited our traveller, and the abundant materials collected by him and carefully sifted by his scientific fellow-workers could not fail to prove useful and help to solve some obscure problems in the natural history of the country.

Thus a comparative study of the two Gayal skulls from Chittagong and Arakan enables Dr. Kühn to clear up several questions touching the mutual relations of the gayal (*Bos gavæus*, Colebrooke), the arni or true wild buffalo (*Bubalus indicus*), the gaur (*Bos cavifrons*, Hodgson), and other members of the ox tribe in India and Indo-China. It now appears evident that the gayal or wild ox of Bengal, Assam and Further India does not differ specifically from the gaur of India proper, as George Vasey and others wrongly supposed. "While the wild gayals' skulls show all the features of the gaur, the forms of the tame gayal from the same locality correspond altogether to the normal gayal type as described by its best observer, Hodgson. Room is thus afforded for the surmise that both types characterise, not two distinct species, but forms only of the same species; that consequently gaur and gayal are specifically one, and that the deviations of the latter in its tame form have merely the value of a variation due to domestication."

Of more general interest are the admirable ethnological and anthropological papers of Dr. Grünwedel and Dr. Virchow, whose learned analysis of the data, and especially of the numerous measurements supplied by Dr. Riebeck, throws a flood of light on the many perplexing questions connected with this obscure ethnical domain. Accepting the already-established broad distinction between the Khyoung-thâ or River Tribes, and Toungh-thâ, or Hill Tribes (Lowlanders and Highlanders), a distinction which has more than a mere geographical significance, these anthropologists find that, on the whole, the hill tribes are of purer descent, that is, represent the aboriginal element more closely, than the riverain populations. The latter (Maghs, Chakmas, Toungjinyas, &c.), have become more intermingled with the Bengalese and other intruders from India, and are characterised by a yellower complexion suggestive of Mongol, or perhaps Malay, affinities. The former (Pankhos, Banjogis, Mros, Kumis, Kukis or Lushais, Shos, Shindus, &c.) are of a darker hue, and seem to approach nearer to the Kolarian aborigines of India. At the same time Dr. Virchow is careful to point out that none of these Hill Tribes lend any support to the theory of an aboriginal Negrito element formerly spread over the whole of India and Indo-China, advocated especially by De Quatrefages and other French ethnologists. "According to unanimous testimony they have all black, long, and smooth, but by no means straight, hair, and, although not athletic, their stature still at once separates them from the dwarfish Andamanese and Negritoes. On the other hand, in further inquiry the question cannot be waived whether the Hill Tribes of Chittagong, perhaps also of Nepal, may not, after all, be somewhat nearly related to the primitive 'black skins' of India. The name Dasyu, or

COMPOSITE PORTRAITS OF AMERICAN SCIENTIFIC MEN.

...DAY, JUNE 25, 1885

## ...TAGONG HILL TRIBES

*...l Tribes. Results of a Tour...* ...y Dr. Emil Riebeck. Translated b... (Asher, 1885.)

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...

Dasa, recalls in a remarkable manner the word Dzo, applied both to the Lushais and their speech."

On the whole the Lowlanders appear to be closely related to the Arakanese, and consequently to the Burmese, and are characterised by distinctly Mongolic features. They may, in fact, be regarded as a Mongoloid people, intermediate between the true Mongols of Northern and Central Asia and the Malays of Malacca and the Eastern Archipelago.

This section of the subject is illustrated by very complete tables of measurements, and by as many as twenty-six photographs of Lushais, Pankhos, Maghs, Chakmas, Tipperahs, and other highland and lowland tribes.

Dr. Riebeck's account of his experiences amongst these children of nature is extremely graphic, and all the more entertaining that the arrangement with his collaborateurs enables him to eliminate all dry technicalities and strictly scientific matter. At the time of his visit a famine prevailed amongst the border tribes in the upper Karnaphuli basin, causing an irruption of Lushais and others into British territory. Thanks to this circumstance he was enabled to procure many valuable articles from the half-famished people in exchange for a little rice and spirits. The circumstances connected with these transactions are related with a frankness which almost savours of excessive candour. "The brandy I concocted myself," he tells us, "by diluting spirits of wine with water, and colouring it with burnt sugar, thereby producing a still more alluring drink for their uneducated palate. In return, they not only parted with a large quantity of their implements, but also allowed me to take bodily measurements and submitted to be photographed by my fellow traveller Rosset. If for brandy I had substituted money, this would have soon found its way into the pockets of the Bengali dealers, who cozened and plundered the natives to the utmost. I may therefore be pardoned if I preferred to tickle the palate of the Lushais with fire-water rather than play into the hands of the blood-sucking usurers."

A tropical thunderstorm, by which he was overtaken in the Ruma district, is described in exceedingly vivid language. "The spectacle which now presented itself was one of the most stupendous imaginable. In a few seconds the firmament became completely overcast; then the welkin towered up, looking in the gleam of the electric flashes like mighty sheaves of flame. The weird effect was heightened by the neighbouring woodlands, which were now all ablaze. For the natives had fired the surrounding bamboo-clad hills in order to clear the land for paddy-fields, and sow their rice in the ashes. Thus was mingled the crackling of the burning and crashing bamboo canes with the roaring thunder aloft, the whole producing a din like that of a neighbouring battle-field."

These passages may also serve as specimens of Prof. Keane's very admirable, faithful, and idiomatic translation. It may be mentioned that the German and English editions, both in folio size and splendidly printed, were issued simultaneously by Messrs. Asher, of Berlin and London. The work forms a sumptuous volume which should find a place in every well-appointed library.

## THE METEOROLOGY OF BOMBAY

*Magnetical and Meteorological Observations made at the Government Observatory, Bombay, 1883, under the Superintendence of Charles Chambers, F.R.S., Rev. Fr. Drechman, S.J., Ninayek Narayen Nene, and Frederick Chambers.* (Bombay, 1884.)

OF the series of volumes entitled "Bombay Magnetical and Meteorological Observations," the present one of forty pages folio is the twenty-fourth. The observations were begun in 1841, and whether we consider the high class character of the observations themselves, the fulness with which they were made from hour to hour, or the long period over which they extend, hey must be regarded as among the very best meteorological records we possess. In the discussion of many of the larger questions of Indian meteorology, such as are from time to time dealt with by the meteorologists of India with so much ability and success, the Bombay observations are simply invaluable; and they are at least of equal importance in the wider questions of the science, and particularly in those cosmical inquiries which have largely engaged the attention of physicists in recent years.

In this report a very satisfactory account is given by Mr. Chambers of the observatory, its position, and surroundings, the instruments in use, and the duties of the various members of the observing staff, all showing that a trustworthiness and an accuracy is secured for the observations which leaves nothing to be desired. Five eye-observations are made every day without exception, at 6 and 10 a.m., and 2, 4, and 10 p.m. In addition to these, continuous registrations are obtained by means of automatic recording instruments, consisting of the magnetographs, the barograph, thermograph, pluviograph, and anemograph, the first four registering photographically and the last mechanically.

From these observations and registrations hourly readings of the various instruments are obtained, and from them the daily means are deduced. These daily means, together with the monthly means, are published in a series of tables appended to the Report. The daily results of the wind observations are given with more than usual fulness,--these consisting of the mean velocity in miles per hour without regard to the direction from which it blew; the aggregate and mean velocities and relative frequency of different winds; and the mean daily velocities of the north or south and east or west components of the winds which blew each day, in miles per hour. At Bombay the greatest mean daily velocity in miles per hour was 31·8 on June 11, and the least 5·2 on October 4; whilst the mean hourly velocity from June to August was 16·2 miles, and from September to May it was only 10·9 miles.

Underground observations are made at depths of 1, 9, 20, 60, and 132 inches below the surface, the first two depths being observed five times daily and the last three once a day, inasmuch as at these depths no diurnal variation is shown. At depths of 1 and 9 inches the monthly maximum and minimum temperatures occurred in December and May, but at the depth of 132 inches these annual phases were delayed till March and July. The mean annual temperature of the air during 1883 was 78°·8.

and of the ground, at a depth of 1 inch, 80°·9; 9 inches, 80°·7; 20 inches, 82°·6; 60 inches, 83°·8; and 132 inches, 83°·2. It is desirable that the errors of these underground thermometers were ascertained.

Down to the close of 1864 the hourly observations made at Bombay were published *in extenso*, and these twenty-four years' hourly observations furnish data for the prosecution of many inquiries, the value of which it would be difficult to over-estimate. From 1865 to 1872 the individual observations ceased to be published, but the hourly means for the different elements continued to be published. From these the hourly means of pressure, temperature, humidity, cloud, thunderstorms, &c., can be obtained for a period of more than thirty years. From the beginning of 1873, however, no hourly observations, or even hourly means, appear in the reports, want of funds presumably being the cause of the omission. Irrespective altogether of the length of time over which the observations have been made and the immense value this single consideration gives to the Bombay observations, the position of this observatory with respect to the monsoons and other vital elements of the meteorology of India render the maintenance of a first-class meteorological observatory in this part of the empire indispensable. It is in truth simply necessary in the interests of Indian meteorology and its satisfactory development that the Bombay Observatory be kept in a state of high efficiency, and that the individual observations made there be published and distributed among men of science at least as liberally as they were previous to 1865.

## OUR BOOK SHELF

*Supplement to "Euclid and His Modern Rivals," containing a Notice of Henrici's Geometry, together with Selections from the Reviews.* (London: Macmillan and Co., 1885.)

We noticed the original work at such length in these columns (NATURE, vol. xx. p. 240), that it is not worth while on the present occasion to do more than draw attention to the issue of this "Supplement."

Prof. Henrici's "Congruent Figures" was published nearly contemporaneously with Mr. Dodgson's book, and so he was unable to discuss the methods employed by the Professor, who, in the words of the present preface, "fills the *rôle* of that popular functionary, dear to Parisian diners, *le quatorzième*."

The discussion forms scene vi. of Act ii., and is headed "Treatment of Parallels by Revolving Lines," and an extract, as usual, leads the way from Henrici's Art of Dining (so our humourist puts it), viz. "in order that an aggregate of elements may be called a spread, it is necessary that they follow continuously."

It will thus readily appear to the readers of the "Euclid and his Modern Rivals," or of our account referred to above—which by the way is honoured by a partial reproduction amongst the review-selections—that Mr. Dodgson is still himself, and that his hand has lost none of its former cunning. We should have liked him to have given his opinions on other parts of the Professor's book, but it has not seemed good to the author so to act, and he has confined himself mainly, if not entirely, to the Lobatschewky treatment of parallels. With two such combatants now fairly in the arena, we shall be content to act as a mere onlooker whilst the strife wages fiercely between them, eagerly noting the parry and the thrust, and ready, if need be, to use the sponge as this or that combatant is struck.

It might be a mighty pretty encounter—Modern Treatment versus the Euclidian.

Mr. Dodgson inserts remarks here and there in the text of the reprinted criticisms: he does not notice that a complaint he makes against us was in great part apologised for on p. 404 (vol. xx., see above).

*Leitfaden bei zoologisch-zootomischen Präparirübungen.* Von A. Mojsisovics Edlen von Mojsvár. 2nd ed. (Leipzig, 1885.)

We are glad to welcome a second edition of this work, which is a very useful manual for museum curators and for demonstrators in the rapidly increasing number of zootomical laboratories. Although it appears to be designed for use in high schools we cannot think that it is likely to displace the manuals already in use in this country: it wants the didactic character of Huxley and Martin's "Elementary Biology," the simplicity and directness of Prof. Milnes Marshall's admirable little book on the "Frog" (which is, we are glad to learn, to be soon followed by others), or the detailed directions of Prof. T. J. Parker's "Zootomy." We may note by the way that these works appear to be unknown to our author, whose knowledge, indeed, of English works on anatomy, or, as Messrs. Wilder and Gage call it, anatomical technology, is very incomplete.

So far as German authorities on "Museologie" are concerned, the second edition appears to have been brought up to date; some additions, not always, however, improvements, have been made in the illustrations; some of the English authors whose works are neglected would have provided the author with a better figure of *Astropecten* than the shocking "representation" which is copied from Bronn. When the third edition is called for we hope we shall find the grave, but perhaps the only important, defect which we have noted corrected and accounted for.

## 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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### On Watering the Coal-Dust in Mines

Referring to an explosion that happened at Lievin Colliery in the Pas de Calais on January 14 last, my friend M. Ed. Sauvage, Ingénieur des Mines, writes as follows:—"Some experiments have been lately made at Lievin Colliery (Pas de Calais), where a disastrous accident happened a few months ago. I do not think any report of these experiments has been published; but they found the coal-dust inflammable, and the watering of the ways in the mine has been resorted to as a precaution against future accidents."

Twenty-nine persons were killed by this accident, that is to say, all who were in the mine with the exception of one. The survivor, a miner named Cornet, and one of his comrades, had prepared a blasting-shot for dynamite, and called upon the shot-firer to ignite it. The latter examined the place, pronounced it to be free from fire-damp, and lighted the fuse.

At the inquest Cornet stated that he saw the shot go off, and had just time, by a quick movement, to throw himself under a heap of straw lying near when the explosion took place. He remembered nothing more, and attributed his escape to the partial protection afforded by the straw.

After investigating the case and hearing Cornet's evidence, the Government engineer and those of the Company who owned the mine came to the conclusion that the explosion was caused by the ignition of the coal-dust that had been lying upon the timbers which formed the supports of the gallery. In corroboration of this opinion they pointed out the fact that the current of air which swept through the gallery in which the explosion originated was too swift to admit of firedamp lodging there.

For some years past a system of more or less careful watering has been practised in some of the largest and driest of the steam coal collieries in South Wales as a precaution against explosions—and the recent occurrences at Usworth, Lievin, Camphausen, and Pendlebury seem to show that similar measures are greatly wanted elsewhere.

Should watering the dust (locally in the neighbourhood of blasting-shots, or generally in the workings) ultimately prove to be the panacea for great colliery explosions, then it is obvious that the responsibility for the holocausts that are now occurring lies almost as heavily upon those who, having the power, fail to hasten its adoption, as upon those who continue to offer it a selfish or factious opposition. W. GALLOWAY

### The Colours of Arctic and Alpine Animals

I MUCH regret that I have been too busy to reply to my friend, Mr. A. R. Wallace (NATURE, April 16, p. 552), till the present moment, but this delay, unavoidable on my part, is the less to be regretted, since it has given an opportunity for the interesting facts recently adduced by Sig. Lorenzo Camerano (NATURE, May 28, p. 77) to be taken into consideration. As Mr. Wallace, with that keen penetration so familiar to all who know him and his writings, goes to the root of the matter under discussion and raises a distinct issue, I will now beg permission to offer a few words in reply to both these gentlemen.

First, with respect to the physical side of the question, Mr. Wallace is perfectly correct in supposing that colour *per se* has no influence upon the radiating or absorbing powers of bodies as far as regards obscure radiation. But I would point out that in the present case we are not concerned with colour alone; we have not merely to consider whether black or white is the best radiator, but we have for comparison two surfaces, hair or feathers, as the case may be, having, as far as we know at present, the same structure, and differing only in colour. The question before us is whether this colour-difference *in the same substance* is associated with any difference in radiating or absorbing power, and the final answer can only be given by carefully conducted experiments. I may add that I have long been waiting for an opportunity of conducting the necessary investigation, and with aid that has been kindly offered from several quarters I hope before long to be in a position to arrive at some satisfactory conclusion. The form of experiment suggested by Mr. Wallace, although decidedly worth the trial, does not appear to me to be very safe, inasmuch as the natural structure and arrangement of the fur would be lost in the process of weaving into cloth. Mr. Wallace's strictures as to the use of artificial dyes are, however, quite sound, and in these I fully concur. I may further state that when this question was raised some years ago, I searched literature (although by no means exhaustively) to see whether any experiments had been recorded, and although many hundreds of observations upon the radiative and absorptive powers of different bodies have been made by various physicists from the time of Franklin downwards, I have not been able to find any experiment bearing directly upon the question under consideration.

The point to be decided is, not only whether dark hair or feathers are better radiators than white hair or feathers, but whether the radiative power of these white coverings is less for that particular kind of radiation which is most greedily absorbed by the substance (snow) among which the animals have to pass their winter existence. Till this problem is solved physically we have, as it seems to me, only the purely biological considerations to fall back upon.

Before passing on to the more strictly zoological side of the subject I should like to disclaim the notion to which Sig. Camerano's letter may give rise, that the radiative (as distinguished from the protective) theory of Arctic colouring is original as far as concerns myself. With respect to the white covering of the warm-blooded animals, this theory was, as far as I knew at the time, original when first broached in 1880; but Lord Walsingham afterwards showed that the same conclusion had been arrived at in 1846 by Craven, with whose name it should be more fairly associated. The application of this theory (in a reversed sense) to explain the melanism of Arctic insects is entirely due to Lord Walsingham, and as my friend Mr. Wallace is disposed to give the weight of his authority to this extension of the theory, there is no occasion to discuss this point further on the present occasion.

It now remains to point out some of the considerations which have led me to the belief that the protective theory of white colouring is not wholly sufficient. Thus, among birds there seems to be a tendency among the falcons (*F. candicans*, *F. islandus*, &c.) to become white in high latitudes—a mode of coloration which does not appear to me to be of much use in such species. These birds, as far as I know, swoop down on their prey from above, under which circumstances the lighter colouring would be of no advantage in enabling them to approach their prey undetected; on the other hand, it can hardly be maintained that these birds are subject to any persecution which would cause their lighter plumage to be of protective value. When on the wing the back only would be seen by another bird hovering over the falcon, and it is noteworthy that this part of the falcons in question is *darker* than the under side. The same considerations apply to the snowy owl (*Nyctea scandiaca*). In many other birds, again, such as the plovers (*Charadrius pluvialis*, *Squatarola cinerea*, &c.) and various species of *Scolopacidæ* (*Tringa variabilis*, *T. subarquata*, &c.), the under side only changes to white in winter—a change which it is impossible to associate either with protection from foes or with predatory advantage. On the other hand, it seems not unreasonable to suppose (on the radiation theory) that the under side of the bird, being nearest to the snow-covered surface of the ground, would require the most protection. It is of interest also to bear in mind from the present point of view that many mammals are known to become white on the under side during winter. Thus, Surgeon-Major Leith Adams, F.R.S., states in his observations on the natural history of Eastern Canada[1] that "there is, moreover, a seemingly strong disposition for the lower parts of animals to become white in winter—*i.e.* the parts in closest contact with the snow; thus the under surfaces of the deer tribe are always whitest. And, as if from its habit of constantly digging among the snow with its snout in quest of food, we find the cariboo with a white patch on its lips and around the hoof, &c." Such facts as these cannot, as it appears to me, be explained on the protection theory; but if any connection exists between the mode of colouring of an animal and its external conditions of life, the theory of preventive radiation or even the direct action of low temperature on the formation of the pigment seems to be more applicable.

The objections raised by Signor Camerano, although supported by some interesting observations, are, I venture to think, somewhat wide of the mark. The writer, indeed, endeavours to bring within the scope of the radiation theory classes of facts which I for one should certainly never dream of attributing to this cause, even if it had been demonstrated on a sound experimental basis. There can be no question as to the truth of his concluding statement that the causes tending to modify the colours are of an extremely complex character. It is this very complexity, indeed, which renders it so highly important to thoroughly investigate any explanation which bears the stamp of truth, though perhaps applicable to but a very limited group of facts. In view of these difficulties, and bearing in mind the inexhaustible resources of nature in adapting organisms to their environment by apparently opposite means, it is not at all surprising that cases should exist which stand apparently opposed to the particular class of cases here dealt with. There are many conceivable ways of enabling an animal to struggle against a severe climate besides that of lightening the colour of its fur, and natural selection would take advantage of any and every means presented for securing this end. To say, therefore, that some animals become darker in winter (*Cervus mandarinus*), or that others do not change colour at all (*Rupicapra europea*, *Capra ibex*), is no real objection to the radiation theory, but simply an illustration of the principle that there are many ways of securing the same result. Thus, in the case of the two last-named species, Sig. Camerano himself states that there is a great difference in the thickness of the winter covering. Then, again, the statement that a more or less distinct seasonal change of colour is observable in many animals appears to me to have no precise bearing on the question—all that can be said from the point of view either of adaptation or climatic protection is that in such slight mutations we have given to us a hint as to the method by which the more striking seasonal changes have been brought about. We must regard such changes either as the incipient stages of a seasonal variation which could, if necessary, be worked up into a more perfect adaptation (*protective* or *climatic*), or as the vanishing remnants of a seasonal variation formerly important, but now useless. The facts that some animals which are not polar or alpine are *permanently* white, that the

[1] "Field and Forest Rambles," 1873, p. 124.

colours of some Alpine Coleoptera are brighter than those of the warmer plains, and that the species of small islands often show a tendency to melanism, are at present simply inexplicable, but, as far as I can see, do not tell for or against either theory. It would certainly be a strong case against the present view if any animal could be named which became white in winter and was not an inhabitant of a country subject to cold winters. As far as my knowledge extends no such species exists. The light colour of desert mammals is most probably due to predatory advantage—the melanism of desert insects mentioned by Sig. Camerano is, I must confess, a new fact to me, and not at all in accordance with my own limited experience. The strongest objection raised by Sig. Camerano is, perhaps, contained in the statement that in the birds of the Antarctic region black is much more prevalent than in those of the Arctic regions. It is unfortunate, however, that the writer adduces in illustration such countries as Australia and New Zealand, which certainly cannot be considered within the Antarctic region.

In conclusion I should like to emphasize that the theory of climatic protection is not, as Mr. Wallace appears to believe, *opposed* to the theory of adaptation. If my first letter gave rise to this impression, I will take the present opportunity of pointing out that the animal kingdom abounds with cases of what our German colleagues happily call "functional change" (*Functionswechsel*)—that is, the conversion of a character (or function) originally acquired for one purpose to a totally new use. It is thus not at all improbable that a mode of coloration originally acquired as a climatic protection, may afterwards be found to be of adaptive value, so that climatic and natural selection would in such cases work together. I fully concede that many of the Arctic and Alpine species now derive such advantages from their white covering; the question is whether this colouring was originally acquired solely for this purpose, or whether climatic adaptation may not have had an equal or even a greater influence in its production.

R. MELDOLA

## Clifford and Professor Tait

MAY a "(so-called) Metaphysician"—who has modestly waited to see if some one for whom Prof. Tait could have more respect would anticipate him—venture to remark upon a passage in the review of Clifford's "Exact Sciences" that appeared in NATURE of June 11?

Prof. Tait first calls "awkward" and "unnecessarily puzzling" Clifford's statement that "if we can fill a box with cubes whose height, length and breadth are all equal to one another, the shape of the box will be itself a cube": and then, declaring with greater emphasis that it "at first sight seems to be nonsense," he adds:—"Read it, however, thus: 'If we can fill with cubes a box whose height, &c. . . . the shape of the box itself will be a cube,' and the absurdity, suggested by the collocation, disappears."

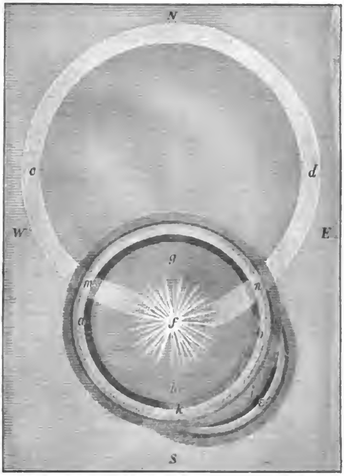
Now Clifford's statement is not sufficiently guarded, being, as it stands, not true of the cube only; but it surely conveys a real meaning, in a "collocation" of words as plain as possible. It is something (whether much or little) to be told that a cube can be made up of a number of equal cubes; especially in view of the context (p. 16). But does Prof. Tait, with *his* sentence, tell us anything at all, except that a cube is—a cube; or say even that plainly?

R.

June 22

## Unusual Atmospheric Phenomenon

THE accompanying drawing—a copy of a sketch taken at the time—represents an unusual atmospheric phenomenon witnessed by several friends and myself during a recent visit to Ireland. It occurred on the 6th inst., a bright warm day, with a light breeze blowing from the east. The sky was free from clouds, excepting a few cirrus and cirro-stratus collections on the northern horizon. Engaged at the time in fishing from a boat on one of the Irish loughs, I was conscious of a change in the character of the light reflected from the water and distant objects and looking towards the sun (*f*), noticed that it was surrounded by an exceedingly brilliant halo (*a b*) of about 48° diameter, the contained space (*g h*) being filled with vapour of a dull leaden blue colour, which, by obscuring some of the solar rays, apparently produced the peculiar light effects that first attracted my attention. The time was 1.30 in the afternoon. Calling the attention of my friend, Dr. Simpson, to the phenomenon, I recorded the accompanying details. The primary halo (*a b*) consisted of a brilliant, well-defined band of about 8° width, composed of the spectral colours in the usual sequence, the red ring being nearest the sun. The whole band was most vivid, but the northern half the brightest. At about two o'clock I noticed a bulging (*i*) of the leaden-coloured vapour of the primary halo (*a b*) to the extent of 6° or 7°, and in its south-eastern quadrant, and this protrusion, at first only faintly fringed with colour, soon was bounded by a spectral bow (*e*) at least as vivid as the brightest portion of the primary halo. The adjacent portion of *a b*, whether by comparison with *e* or whether because partially obscured by the protrusion of the vapour around which *e* was formed, I cannot be sure, seemed much paler than the rest of *a b*. Simultaneously with the formation of this secondary bow a large white ring, represented in the drawing by *c d*, slowly formed around a centre to the north of the sun, and rapidly assumed a well-defined contour. Its diameter was 72°. Had it been complete it would in its southern portion have passed through the sun, but after cutting the primary halo (*a b*) at the points (*m* and *n*),




which it rendered more faint, it gradually disappeared before reaching the sun. This latter ring (*c d*) began to disappear about a quarter of an hour after I first noticed it, its north-western portion fading first. I noticed no mock-suns at the points of contact of either of the excentric rings, and was, unfortunately, unprovided with my small pocket polariscope, and therefore unable to ascertain how much of the phenomenon was due to double refraction. The portion (*e*) may have been thus produced, but it certainly appeared, as drawn, to be a portion of a ring of *smaller* radius than (*a b*). The Rev. T. G. Beaumont, who also observed this spectacle, states that he saw the primary halo (*a b*) gradually start from a much smaller ring around the sun. The accompanying drawing, though rough, is as accurate as compatible with the absence of measuring instruments.

ALEX. HODGKINSON

26, King Street, Manchester, June 16

## Sky-Glows

YOUR correspondent of Clairvaux-sur-Aube says (NATURE, vol. xxxii. p. 147) the sky-glows are again visible in France. I can corroborate the fact as regards the valley of Lake Leman, in Switzerland. At Geneva, a newspaper has described the abnormal crepuscular glows of June 2, 3, 4, and 13. At Morges (46° 30′ N. lat.), Prof. C. H. Dufour and myself have observed them on the 12th and 13th.

On the 12th the sun disappeared beyond the Jura range about 7h. 30m. p.m.; at 8h. 10m. my attention was called by the brilliant illumination of a strange pale yellow, the same which in December, 1883, and January, 1884, always foretold the great crepuscular glows; at 9h. the western sky was coloured by brilliant purple red tints, which spread as high as the zenith; the red colour only vanished from the horizon at 9h. 30m.—*i.e.* two full hours after sunset. The successive phases of the phenomenon were the same as in the winter 1883-1884; the brilliancy of the colours was, however, fainter, but they were, perhaps, of greater duration.

On the 13th the same glows were observed, with decreasing intensity; on the following days nothing extraordinary has been noticed.

F. A. FOREL

Morges, Switzerland, June 21

## *THE INTERNATIONAL EXHIBITION—MUSIC LOAN COLLECTION*[1]

THE story runs that a countryman, visiting London for the first time, and feeling bound to see Westminster Abbey, by a slight mistake overlooked the Royal Fane, and attended service in St. Margaret's Church hard by. He told his friends in the shires on coming home that the ancient edifice was sadly overrated. Exactly a parallel case to this has just occurred to the writer of the present lines. He was informed by an unknown friend that the small collection of unlabelled instruments in the basement of the Albert Hall was unworthy of the occasion; and he only made out on close inquiry that the person in question was speaking of one out of the two "overflow rooms" in which the superabundant stores of the Loan Collection are housed, and had never seen the Loan Collection itself at all. This was the more remarkable as the said individual carried the proof-sheets of his guide-book to the Inventories which he was in the act of sending to the printers. It is therefore clearly not superfluous to state that this, probably the grandest and most complete illustration of the history, progress, and development of music ever furnished, occupies the whole of the circular gallery which forms the top storey of Capt. Fowke's gigantic building, and runs over into two large rooms at a lower level.

It is impossible in a short preliminary notice to do more than call early attention to the vast mass of priceless materials here collected, and soon to be again dispersed; nor can sufficient credit be accorded to Mr. Alfred Maskell, who, aided by his learned father, has been mainly instrumental in arranging and bringing it into order. He has been seconded signally by Mr. Hipkins, representing the old and honoured firm of Broadwood and Sons, so that the collection of ancient spinetts, virginals, clavichords, harpsichords, and the like is the most remarkable ever brought together. There is at least one such instrument lent by its noble owner from his family seat in Ireland which is all but unknown even to connoisseurs.

The Belgian Government have most liberally lent the whole of the grand museum of the Brussels Conservatoire of Music, originally presented to that institution by M. Victor Mahillon. This in itself is a "*Syntagma Musicum*," like the scarce work of Prætorius, but presenting the very things themselves, not merely their graven images.

The realism of the exhibit is carried to the highest degree by three beautiful model rooms, designed with the taste and accuracy for which Mr. Davidson, himself an exhibitor of some grand fiddles, is so justly noted, each room showing furniture, decoration, and instruments of a great epoch in musical history. The visitor can, if he choose, yield to the pleasant illusion and revel in the madrigals of Orlando di Lasso, "*Il più dolce cigno d'Italia,*" the motetts of the Elizabethan age, the Lulli-inspired melodies of Purcell; or sit at the clavichord with Handel and grand old John Sebastian Bach. Of its kind the thing is as nearly perfect as can be, and the undersigned takes the first possible opportunity of praying his brother and sister amateurs not to let slip the unique privilege of seeing it.

W. H. STONE

[1] We hope to supplement this preliminary note by a more detailed notice of the collection when it is complete and the Catalogue ready.—ED.

## *THE MEASURE OF FIDGET*

LATTERLY—no matter where—I was present at a crowded and expectant meeting. The communication proved tedious, and I could not hear much of it, so from my position at the back of the platform I studied the expressions and gestures of the bored audience.

The feature that an instantaneous photograph, taken at any moment, would have most prominently displayed was the unequal horizontal interspace between head and head. When the audience is intent each person forgets his muscular weariness and skin discomfort, and he holds himself rigidly in the best position for seeing and hearing. As this is practically identical for persons who sit side by side, their bodies are parallel, and again, as they sit at much the same distances apart, their heads are correspondingly equidistant. But when the audience is bored the several individuals cease to forget themselves and they begin to pay much attention to the discomforts attendant on sitting long in the same position. They sway from side to side, each in his own way, and the intervals between their faces, which lie at the free end of the radius formed by their bodies, with their seat as the centre of rotation varies greatly. I endeavoured to give numerical expression for this variability of distance, but for the present have failed. I was, however, perfectly successful in respect to another sign of mutiny against constraint, inasmuch as I found myself able to estimate the frequency of fidget with much precision. It happened that the hall was semicircularly disposed and that small columns under the gallery were convenient as points of reference. From where I sat, 50 persons were included in each sector of which my eye formed the apex and any adjacent pair of columns the boundaries. I watched most of these sections in turn, some of them repeatedly, and counted the number of distinct movements among the persons they severally contained. It was curiously uniform, and about 45 per minute. As the sectors were rather too long for the eye to surely cover at a glance, I undoubtedly missed some movements on every occasion. Partly on this account and partly for the convenience of using round numbers I will accept 50 movements per minute among 50 persons, or an average of 1 movement per minute in each person, as nearly representing the true state of the case. The audience was mostly elderly; the young would have been more mobile. Circumstances now and then occurred that roused the audience to temporary attention, and the effect was twofold. First, the frequency of fidget diminished rather more than half; second, the amplitude and period of each movement were notably reduced. The swayings of head, trunk, and arms had before been wide and sluggish, and when rolling from side to side the individuals seemed to "yaw"; that is to say, they lingered in extreme positions. Whenever they became intent this peculiarity disappeared, and they performed their fidgets smartly. Let me suggest to observant philosophers when the meetings they attend may prove dull, to occupy themselves in estimating the frequency, amplitude, and duration of the fidgets of their fellow-sufferers. They must do so during periods both of intentness and of indifference, so as to eliminate what may be styled "natural fidget," and then I think they may acquire the new art of giving numerical expression to the amount of boredom expressed by the audience generally during the reading o any particular memoir. F. G.

## RECENT EARTHQUAKES

THE shocks of earthquake in Cashmere continue with unabated violence and even appear to increase in frequency and force. Three severe shocks occurred during the night of the 13th and a smart convulsion on the morning of the 14th. It is now ascertained that 2281 lives were lost in the Muzzafferabad district, where at first it was thought there had been no casualties. The earthquake was also felt in Gilghit. Another very severe shock at Baramulla on the 17th demolished all the buildings which escaped former shocks. At Skardo on the 14th and at Srinugur on the 17th, 18th, and 19th, shocks were felt. In the Kamraj district the loss of life exceeds 2700. The Jheelum Valley, from Srinugur to Dopatta, appears to have suffered most. It is stated that both sides of the nver from Sopur to Baramula have been seared with cracks, as also the low alluvial hills in the vicinity. The available data fix the centre of the disturbance in the vicinity of Gurais. It thus appears that in extent and amount of destruction the Cashmere earthquake must rank amongst the great seismic catastrophes of the century.

On Thursday morning last (June 18) a portion of Yorkshire was visited by an earthquake shock. The reports from outlying districts show that the shock extended from the east coast through the Wolds and westwards as far as Headingley, near Leeds. Signalmen on the North-Eastern Railway speak positively as to the vibration and noise. Crockery and glass rattled on the shelves of houses, and at Knottingley and Ferrybridge persons ran from their houses from fear. At Easingwold desks and tables were seen to move, and there was a rumbling noise as of thunder. In some cases there was a severe shaking of houses, and doors were moved. The various reports concur as to the time being 10.50, and it is said there were two shocks. It is a curious coincidence that about an hour previous to this on the same day and in the same region the frightful explosion at the Clifton Hall Colliery took place. Unhappily our knowledge will not permit us to connect seismic disturbances with disasters or mishaps in mines, but we have here a violent and unusual disturbance in the crust of the earth in Yorkshire and an almost simultaneous mining catastrophe in Lancashire.

We have received the following communications with reference to the Yorkshire earthquakes:—

A SLIGHT shock of earthquake was felt here yesterday morning in the favourable stillness of the "Friends'" meeting for worship. The time was observed to be about 10.47 a.m. I was seated with my back to the north, when a rumbling sound appeared to be swelling onwards for about two seconds from the south or south-west. I then noticed that the hanging leaf of a small table in front of me (its plane lying east and west) was rattling very distinctly, and immediately I became aware that the back of my seat was shaking me perceptibly. Others heard some of the windows rattling on both the east and west sides of the house, and were shaken by their seats moving slightly; these seats were some of them at right angles to mine. Some of these persons thought the rumbling came from the east; others from the west. One gentleman, sitting in a corner, thought that his right shoulder, against a north partition, was shaken more than his left, against the east wall. He also thought that the rumbling came from the south end of the house. The place of worship is about two-thirds of a mile to the north-east of our observatory, which is in lat. 53° 38′ 40″·8, and long. 1° 20′ 32″·75 W. Nothing was noticed at the time by a man and a boy working in our garden. It is reported in to-day's *Leeds Mercury* to have been felt at York, Leeds, and Driffield. WILLIAM SCARNELL LEAN

Flounders College, Ackworth, near Pontefract, June 19

CAPT. STAVELEY, at whose house the recent earthquake of June 18 was felt in a marked degree, gives me the following information respecting it. His house at North Dalton (seven miles south-west of Driffield) stands on a slight elevation surrounded with undulating hills common to the Cretaceous formation of the Wolds. The shock occurred between 10.30 and 10.45 a.m. (the exact time was not noted), and lasted about three seconds, travelling from west-south-west to east-north-east. Mrs. Staveley, who was in her bedroom at the time, felt a slight shock, then a rumbling sound as of thunder, and after that another stronger shock. The servants downstairs felt a distinct rocking, and the bricklayer's boy, on a ladder level with the roof, saw the whole roof heave up and down three times. In the dairy some dishes firmly placed on a high shelf were thrown down and broken, and at the inn on the other side of the road the walls trembled perceptibly, and the bottles and glasses were shaken and knocked against each other. The inhabitants of this and neighbouring villages felt the vibrations more or less distinctly, but the shock seems to have been greatest at, and in the direction of, Capt. Staveley's house. The colliery explosion near Manchester happened about an hour earlier; is it possible for there to be any connection between the two? J. LOVELL

Driffield

The following extracts are from the *Hull Express* of June 20:—

Information which reached us yesterday shows that the earthquake-shocks experienced on Thursday in York and Market Weighton were also felt in more or less degree in other parts of the great shire.

Mr. W. Botterill, of Parliament Street, Hull, writes:—"On returning home (Newland Park) from business last evening, my wife informed me that during the morning she had for some seconds very sensibly felt a vibratory motion in the house, which she fully believed to be caused by a slight shock of earthquake, and added that she should confidently expect to find in this morning's papers notices in confirmation thereof. It was, therefore, no surprise to learn from your current issue, and other papers of to-day, that similar effects had been experienced at York, Market Weighton, and elsewhere, about the same hour of the day."

A North Cave correspondent says that at about eleven o'clock in the morning nearly every house was subjected to a slight shaking.

A Driffield correspondent says that at the village of Hutton several residents felt a severe shaking of their houses, and at the same time the inner doors were suddenly moved, crockery upset, and other signs of disturbance were observed. People were so terrified that they cannot very accurately describe the shock, but state they felt a "reeling" sensation.

Another correspondent writing from Driffield says:—"Yesterday morning a somewhat severe shock of earthquake was felt at North Dalton, a village about eight miles from Driffield. The shock appears to have been the most distinctly felt at the residence of Capt. Staveley, which stands in an isolated and elevated position, and the house vibrated from basement to roof for several seconds. A bricklayer's apprentice who was repairing the roof had a narrow escape of being thrown down, and the greatest alarm was felt by the villagers, who 'ran out of their houses in fear for their lives.'"

The shock was also distinctly felt in Leeds. In Delph Lane, Wood-house Ridge, the occupants of three houses which adjoin each other noticed it. It resembled the effect which would be produced by the violent shutting of doors, the windows rattling, and there being a perceptible vibration of the buildings. The same tremulous motion was also felt in Victoria Road, Headingley, and no doubt in other parts of the town.

At Snaith and neighbourhood similar effects were produced. Mr. Harrett, the postmaster of that town, says the shock was so severe as to cause quite a noise with the goods on the shelves in his shop window vibrating, and he felt the floor under him shake distinctly. At 10.45 a.m. on Thursday morning an earthquake was distinctly felt at Thorne, Hatfield, Epworth, and Eastoft. At various parts of Thorne crockery and glass rattled upon the shelves in the houses, furniture was shifted, and many of the inhabitants were greatly alarmed by the floors slightly descending. At Hatfield Levels also some consternation was caused by the earthquake, which was felt very perceptibly. We have not heard of any damage being done by the shock.

About one o'clock on the morning of the 18th, north-western Argyleshire was visited by an earthquake. The shock was distinctly felt at Ballachulish, and in many of the houses in the slate quarry district of Glencoe. The shock was felt with distinctness in Clachaig Inn, at the top of Glencoe. It travelled in a south-eastern direction.

Dr. Forel, of Morges, writes that a pretty strong shock was felt on the morning of June 2[illegible] at 5.16, in the cantons of Neuchatel, Vaud, Berne, Fribourg, and Geneva, the seismic centre being probably the neighbourhood of the Lake of Neuchatel. The intensity was No. IV. of the scale of seismic intensity.

## THE SCOTTISH MARINE STATION

THE equipment of the Research Station at Granton, Edinburgh, has now been increased by the construction of a system of large tanks provided with a constant circulation of sea-water. These tanks are arranged very nearly according to the plan described in the account of the station and its work which was published in April last. The aquarium itself occupies the ground floor of the building, whose upper story forms the biological laboratory, and it consists of seven large tanks, five of which are shallow, and two deep, the latter being provided with glass fronts. The pump, which is driven by a steam-engine, the high-level reservoir and the low-level reservoirs are situated at other parts of the premises. One of the deep tanks is being used for the study of the still mysterious life-history of *Myxine glutinosa*. Last week nearly 150 specimens of this animal were brought alive to the station from the [illegible] off St. Abb's Head, where it is very abundant. These were successfully domiciled in the aquarium. A [illegible] of these specimens brought alive to the "Ark" [illegible] floating laboratory belonging to the station [illegible] kept in a small glass aquarium [illegible] two are still alive and healthy [illegible] good reason to hope that there will [illegible] keeping a large number alive for [illegible] tank about 7 feet by 5 feet by 4 feet [illegible] of the one now used for the purpose [illegible] found in the former experiment that the Myxine, when left to themselves, burrowed into the layer of sand which had been placed at the bottom of the small aquarium, and lay for hours motionless [illegible], with the exception of the extreme tip of the snout [illegible]. The snout is protruded for the purpose of respiration, currents of water passing continually through the nostril into the [illegible] and escaping at the two respiratory apertures. The normal condition of the animal when not actively engaged in the search for food is evidently to be thus buried in mud. It is well known to fishermen, at least to those who are employed in line-fishing, that eellets, as Myxine are called by them, are met with almost exclusively on muddy ground. At the place where the creatures are more abundant than anywhere else in the neighbourhood of the Firth of Forth, namely, off St. Abb's Head, the sea-bottom throughout an extensive area consists of soft black mud. A quantity of this mud was brought to the station with the living specimens, and a layer of it 6 or 8 inches in depth placed at the bottom of the tank in which the Myxine were to be kept. The animals are now thickly scattered through the layer of mud, like earthworms in garden soil.

Some of the shallow tanks are being used for the study of the reproduction of the oyster. Supplies of oysters are being obtained from various sources, and before long a series of experiments as to the conditions necessary to the life of the oyster larvæ will be carried out. It is hoped, as the least result from this work, that new interest will be aroused in this country in the question of the scientific artificial cultivation of oysters.

The opportunities afforded for research by the laboratory and new aquarium cannot be fully utilised by those now working at the Station, and biologists who would come and carry out original work at the Station would be gladly welcomed.

A temporary branch of the station is now being organised at Millport, on the Firth of Clyde. It will be open during the months of July and August. The floating laboratory known as the "Ark" will be moored next week in still water off one of the small islands in the Bay of Millport, and the yacht *Medusa* will be stationed there for the purpose of dredging and providing material for study. Several naturalists have made arrangements to carry on work at Millport during part or whole of the time that the "Ark" will be there, amongst others the Rev. A. M. Norman, Prof. W. A. Herdman, of University College, Liverpool, Mr. David Robertson, of Glasgow; Mr. [illegible] Harvey Gibson, Mr. J. R. Henderson. Mr. John Murray, convener of the Committee, entrusted with the management of the Scottish Marine Station, will be at Millport during the greater part of the time. It is hoped that one result of the work will be the preparation of an account of the fauna of the Firth of Clyde which will include, besides the results of the investigations to be carried on, the results of the previous work in the same field. As several of the experienced naturalists mentioned above are already familiar with the fauna of the Firth, a publication on the subject produced by their cooperation will be complete and authoritative. Any naturalists who may wish to carry on research at the Millport temporary station are invited to communicate with Mr. John Murray.

J. T. CUNNINGHAM

## COMPOSITE PORTRAITS OF MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES[1]

THOSE of the members who were present at the Washington meeting of the Academy last spring will remember that, at the request of Prof. Brewer and others, they sat for their separate photographed portraits for the purpose of obtaining an experimental composite picture. Prof. Baird kindly offered the facilities of the photographic department; and the pictures taken by Mr. Smillie, the photographer in charge, bear the same stamp of excellent characteristics as generally the work of that department of the National Museum.

As only one or two previous attempts, I believe, have been made to produce composites in this country, I will state briefly what they are, and how they are made.

The idea in its broadest sense was conceived and applied by Francis Galton for the purpose of obtaining an average or type portrait, i.e. a picture that should show the features that are common to a group of individuals, and exclude those that are purely individual. It is clear that, in proportion as this result is attainable, the method will be of value in obtaining a clear conception of the external characteristics of any given type or class.

Galton reminds us that, during the first days of a traveller's meeting with a very different race, he finds it impossible to distinguish one from another, without making a special effort to do so: to him the whole race looks alike, excepting distinctions of age and sex. The reason of this is that, by short contacts with many individuals, he receives upon his retina, and has recorded upon his memory, a composite picture emphasizing only what is common to the race, and omitting the individualities. This also explains the common fact that resemblances among members of a family are more patent to strangers than to the relatives.

The individuals entering into these composites were all photographed in the same position. Two points were marked on the ground glass of the camera; and the instrument was moved at each sitting to make the eyes of the sitter exactly coincident with these points. The composites were made by my assistant, Mr. B. T. Putnam, who introduced the negatives successively into an apparatus carefully constructed by himself, and essentially like that designed by Mr. Galton, where they were photographed by transmitted light. The arrangements of the conditions of light, &c., were such that an aggregate exposure of sixty-two seconds would be sufficient to take a good picture. What was wanted, however, was not an impression of one portrait on the plate, but of all the thirty-one; and to do this required that the aggregate exposure of all the thirty-one should be sixty-two seconds, or only two seconds for each. Now, an exposure of two seconds is, under the adopted conditions, too short to produce a perceptible effect. It results from this, that only those features or lines that are common to all are perfectly given, and that what is common to a small number is only faintly given, while individualities are imperceptible. The greater the physical resemblances among the individuals, the better will be the composites. A composite of a family or of near relatives, where there is an underlying sameness of features, gives a very sharp and individual-looking picture.

It would be difficult to find thirty-one intelligent men more diverse among themselves as regards facial likeness than the academicians entering into this composite. They are a group selected as a type of the higher American intelligence in the field of abstract science, all but one or two being of American birth, and nearly all being of American ancestry for several generations. The faces give to me an idea of perfect equilibrium, of marked intelligence, and, what must be inseparable from the latter in a scientific investigator, of imaginativeness. The expression of absolute repose is doubtless due to the complete neutrality of the portraits.

Fig. 3 contains eighteen naturalists and thirteen mathematicians, whose average age is about 52 years. Fig. 1 contains twelve mathematicians, including both astronomers and physicists, whose average age is about 51⅚ years. Fig. 2 is a composite of sixteen naturalists, including seven biologists, three chemists, and six geologists, with an average age of about 52½ years.

I may mention, as perhaps only a remarkable coincidence, that the positives of the mathematicians, and also of the thirty-one academicians, suggested to me at once forcibly the face of a member of the Academy who belongs to a family of mathematicians, but who happened not to be among the sitters for the composite. In the prints this resemblance is less strong, but in these it was observed quite independently by many members of the Academy. So, also, in the positive of the naturalists, the face suggested, also quite independently to myself and many others, was that of a very eminent naturalist, deceased several years before the sitting for this composite.

There is given also a composite (Fig. 4) of a differently selected group. It is of twenty-six members of the Corps of the Northern Transcontinental Survey—an organisation of which I had charge, and the object of which was an economic survey of the North-Western Territories. It was a corps of men carefully selected as thoroughly trained in their respective departments of applied geology, topography, and chemistry, and having the physique and energy, as well as intelligence, needed to execute such a task in face of many obstacles. The average age of this group was 30 years. RAPHAEL PUMPELLY

## *HOW THE NORTH-NORWAY FJORDS WERE MADE*

IN NATURE (vol. xxx. p. 202) there was published an article by me "On Northern Norway under the Glacial Age," in which, among other subjects, I referred to the course of the travelled granite blocks in the neighbourhood of Tromsö. The researches I had then made in this direction were, however, confined to a limited area, whilst last summer I was able to extend the same to the point whence the blocks started. Although one of my assumptions in the former article has not been confirmed by my last researches, the conclusions I then arrived at have in the main been corroborated. And as I believe that this subject is one of considerable importance to science, I venture to give an account of my last researches.

In order to understand the subject, it is necessary to explain the orographical conditions along the course of the travelled blocks from the Swedish frontier to the Arctic Ocean.

From the eastern end of the Alt Lake, near the Swedish frontier, and northwards to the Store Rosta Lake, the country on the Norwegian side assumes the form of an extensive alpine plateau, with broad depressions, the average height of which is about 2000 feet, running between low rounded ridges. In the south-eastern part of these plateaux, not far from the eastern end of the Alt Lake, the Divi River rises. Having for some 10 graphical English miles followed the plateau, this river flows gradually towards the Divi Valley, which it enters and follows throughout its whole course in a north-easterly direction, flowing eventually into the Maals River at a height of 260 feet (82 m.) above sea-level. Its length, from where it leaves the plateau, to the spot where it joins the Maals River, is about 30 geographical miles. In its upper course, where the Maals River receives the Divi River, the former flows through a wide plain or low plateau, the so-called Överbygd, which gradually slopes down to a distinct valley, the Maals Valley proper, which runs in a westerly direction along the southern slope of the high, island-shaped mountain ridge called Mauken. The latter begins about 5 miles west of the spot where the Divi River enters the Maals River, whence it runs in a direction east-west for a length of about 15 geographical miles, the highest tops being upwards of 4000 feet (1255 m.). On the north-western side, however, the Överbygd gradually rises towards the broad mountain depression filled by the Tag Lake, 7 miles in length, which runs in a direction east-west along the northern slope of Mauken, viz. between the latter and the more northerly-lying ridge Omasvarre, which, with tops upwards of 1900 feet (596 m.) in height, also runs in a direction east-west. The bottom of this depression is filled with the imposing Tag Lake, which lies on a height of about 600 to 700 feet (188 to 220 m.) above sea-level, and thus about 400 feet (120 m.) *higher* than the Divi River at the spot where it enters the Maals River. At the western end of the Tag Lake this depression takes the form of a broad mountain basin, the so-called Tag Valley, which in a north-easterly direction descends to Balsfjord. The distance between the Tag Lake and the Balsfjord is about 10 geographical miles. The Tag Valley is, on the western side, bordered by the lofty Maartin peaks, and further to the north-east by the Slet

Mountain, which, like an arm of the Maartin peaks, gradually slopes down to the Balsfjord.

The line of depression from the spot by the frontier where the Divi River rises, to the bottom of the Balsfjord which we have thus followed, is about 50 geographical miles in length. The course of the Balsfjord is northwesterly, but very crooked, between mountains upwards of 4000 feet (1255 m.) in height. The latter are, however, not continuous, but separated into island-like parts by deep depressions, which, in a recent geological period, when the level of the sea was 300 to 400 feet (91 to 126 m.) higher than at present, must have been submerged, thus making each part an island. In spite, therefore, of the typical fjord character of the Balsfjord, it was originally only a number of sounds, by which it was once connected with the Malangen Fjord on the western, and the Sorfjord, Ulfsfjord, and Lygenfjord on the eastern side. This is a circumstance of great orographical importance, and which deserves every attention, particularly because it does not apply to the Balsfjord alone, but is a characteristic of the formation of every fjord in the north of Norway from Salten (Bodö) in the south to Lyngen in the north—*i.e.* from 67° to 70° N. lat.

From the bottom to the mouth, in a sound between the mainland and the south-eastern side of the great island, Kvalö, the length of the Balsfjord is about 30 miles. At the Troms Island, which lies about five miles to the north of the mouth of the Balsfjord, this sound is divided into two narrow sounds, about five miles long, on each side of the Troms Island. From the northern point of this island these sounds reunite, and the sound becomes the broad Gröt Sound on one side, which, running in a northerly direction, joins the Ulfsfjord at its mouth by the Fugle Sound—a broad arm of the sea cutting into the land. On the other side, the sound is also connected with the open sea by the Kval Sound, 10 to 15 miles long, which runs in a westerly direction, between the two great islands Kvalö and Ringvadsö. The length from the mouth of the Balsfjord to the end of the Kval Sound by the ocean is about 30 miles, or about the same as the length to the end of the Gröt Sound. Thus, from the bottom of the Balsfjord to the sea the distance described is about 60 miles.

As regards the depth of the Balsfjord and the adjacent sounds, it may be mentioned that that of the former varies from 80 to 100 fathoms (480 to 600 feet = 151 to 188 metres), but from the mouth of the fjord towards the Troms Island the depth steadily decreases, being, in the sounds on both sides of it, not more than 20 to 30 fathoms (120 to 180 feet = 38 to 56 m.). To the north of this island, in the Gröt Sound, on the other hand, the depth increases to 100 or 120 fathoms. In the eastern half of the Kval Sound the depth is from 20 to 30 fathoms, while in the western half it reaches, at the mouth, 120 fathoms. It will therefore be seen that the depth of this channel in the main increases seawards, if we except the two places by the Troms Island and in the Kval Sound, the shallowness of which may be caused by narrowness of the sounds, and the consequent opportunity for the deposit of marine *débris*.

Thus, the entire length of the line of depression we have examined from the sources of the Divi River to the ocean is 96 geographical miles, while the bottom of the same falls from 2000 feet above the level of the sea to 720 feet below it—*i.e.* a total fall of 2720 feet.

The geological structure of the mountains here is very remarkable. A large mass of granite which appears at each end extends inland far into Sweden, and, on the Norwegian side, reaches the upper Divi Valley. The rock is composed of orthoclase, microlin, plagioclase, a great deal of quartz, but very little mica. The colour is reddish, the structure granulated. At the other end of the line we have followed, on the Kvalö and Ringvadsö Islands, there are several masses of a grayish, streaky gneiss-granite, rich in mica, closely allied to the gneiss-masses found here. Petrographically, the Divi Valley and the coast granites are so different, that it seems at first sight very easy to distinguish them, but this is not so easy with the variations of the two kinds.

The mountains which project into these granite-masses are built of layers of crystalline slate, and travelled blocks of this material may be found everywhere; but as it would be a matter of great difficulty to refer these to their original birthplace, I shall not take them into account here. We will, therefore, only follow the course of the granite blocks travelling from the Swedish frontier to the coast.

There are two roads by which they might have moved, viz., one from the southern part of the granite-mass along the Alt Lake to Bardö, and so on; the other more northerly, along the Divi Valley. It is the latter which I intend to discuss here.

The above-mentioned alpine plateaux are strewn with travelled granite blocks, and that the same have travelled westwards from the granite masses by the frontier cannot be doubted. The same applies to all the blocks strewn along the Divi Valley. At the spot where the Divi River joins the Maals River the travelled blocks have followed two courses—viz. one through the Maals Valley, along the mountain Mauken—which we shall not follow—and the other in a north-westerly direction across the Överbygd to the Tag Lake, the lower parts of the Överbygd being thickly strewn with granite blocks which, judging by their petrographical composition, I am sure belong to the Divi Valley granite. Hence the course of the blocks can be traced along the depression in the mountain by the Tag Lake, not only at the bottom, but high up on the mountain sides. Thus, the northern slope of the Mauken is everywhere, up to a height of 2500 feet (784 m.), strewn with travelled granite blocks; indeed the brink of every terrace looks—seen from below—as if it were faced with travelled blocks, which everywhere seem to belong to the Divi Valley granite. Travelled granite blocks were found, too, strewn up the slopes of the Omasvarre Mountain to a height of 1200 feet (376 m.)—viz. as far as I was able to carry my researches. I believe they would be found right up to the top.

From the western end of the Tag Lake the blocks have moved along the Sag Valley, and then to the bottom of the Balsfjord. The flat stretch of shore, 210 feet broad, high, and covered with loose *débris*, is strewn with blocks which without doubt belong to the Divi Valley granite.

From what I have thus explained we may safely assume that an enormous mass of inland ice has once moved from the frontier through the above-described channels, down to the Balsfjord, and that it must, along the Mauken, a distance of 10 miles from the fjord, still have maintained a height of at least 2500 feet (784 m.) above the then sea-level.

Before we follow the course of the blocks further, I will refer to certain circumstances connected with it thus far. About five miles to the westward of the mountain plateau near the frontier rises the isolated mountain Store Jerta to a height of 4500 feet (471 m.)—viz. about 1000 feet (314 m.) higher than any of the surrounding mountains. The Store Jerta is throughout built of hard crystalline slate. On the very summit of this peak I found a large block of granite which I feel confident is a travelled block from the granite mass to the east of it. Its birthplace must in that case have been at least 1000 feet (314 m.) *lower*, and, as the Store Jerta has been situated right in the track of the ice-stream from the east, I am of the opinion that the ice has been screwed up here to a very great height; but I confess it seems hardly possible to understand that it could be to such an enormous height.

I have stated above that the Tag Lake lies 42 feet *higher* than the spot where the Divi River enters the

Maals River, and supposing that this was also the case during the Glacial age the ice-stream must have moved up an incline before it could reach the depression leading down to the Balsfjord. This cannot, however, have been the case. As long as the ice-stream had perfect liberty to travel *down* an incline—here present in the shape of the broad Maals River, along the southern slope of the Mauken—it would hardly ever move in the opposite direction *up* an incline, leaving, however, local accumulations out of consideration. It might therefore be reasonable to suppose that the configuration of the land along the Divi Valley, and especially the Överbygd, was very different during the Glacial age. A continuous, though slightly inclining, surface must under these circumstances at that period have extended from the alpine plateaux above the Divi Valley to the depression along the Tag Lake, and the present configuration be caused by subsequent erosion. It should be stated that the outlet of this lake does not now follow the course of the ice-stream towards the Balsfjord—which might have been reasonably assumed—but is at the opposite, eastern, end towards the Maals River. This seems to indicate that the present declivity of the Överbygd in an easterly direction in any case cannot be older than the close of the Glacial age.

As stated, travelled granite blocks from the Divi Valley are found in great numbers along the northern slope of the Mauken, towards the Tag Lake, upwards of 2500 feet (784 m.); but that these should have been raised from lower levels to their present height seems improbable. The northern slope of this mountain does not lie transversely to the course of the ice-stream, but longitudinally to it. Of course the screwing-up of the ice may also take place in the latter case, but I should say only in isolated spots; this cannot have been the case along the Mauken. Neither is it possible that the bottom of the lake lay at that level in the Glacial age. It must then have lain lower than the alpine plateaux by the frontier, and even if we allow for enormous glacial erosions, it would be impossible to believe that the bottom then lay at such a height. As the blocks on the Mauken cannot thus have been deposited along the bottom of the ice-stream, nor brought thither through screwing-up of the ice, we must assume that they have been deposited from the surface of the ice-stream. The latter being strewn with blocks, which at the frontier was above 3000 feet (941 m.) high, has therefore, at 40 or 50 miles therefrom, had a height of 2500 feet. The surface can, therefore, under this long journey, only have had a very small declivity outwards.

From the western end of the Tag Lake the great ice-stream has moved forward to the Sag Valley, which, being then as it is at present, has been able to receive it and turn it in a north-westerly direction downwards to the Balsfjord. That the Sag Valley cannot be of glacial origin, produced by erosion, is clear from the very nearly acute angle it forms with the Tag Lake depression. It might also be assumed that the ice-stream here might have moved forward across the Slet Mountain and the long, narrow peninsula between the Malangen and Balsfjord, but that this was not the case is proved clearly by the circumstance that travelled granite blocks are found on this peninsula, or only at low levels, which I shall presently explain.

It may be probable that the ice-stream from the Tag Lake has met another descending from the Maartinder in the Sag Valley, but there is no middle *moraine* proving this. On the other hand, travelled granite blocks are but sparsely strewn along the north-western side of the Sag Valley, at the foot of the Slet Mountain. Should the Sag Valley, therefore, be of glacial origin, it might more naturally be attributed to the ice-stream from the Maartinder, but even then eroded before the great inland ce-stream entered it. If, however, this was the case, the former ice-stream must have been in motion long before the latter, of which there is no probability.

We therefore come to the conclusion *that the basin of the Balsfjord, viz., the Tag Lake depression and the Sag Valley, cannot be the result of the erosive action of the inland ice, but that it existed prior to the Glacial age, and that, in fact, the depression in question was the cause of the ice-stream taking this course.*

We will now follow the depression through the fjord and adjacent sounds.

As soon as we leave the true bottom of the fjord the travelled blocks are differently situated to those inland. There are plenty of granite blocks to be found, but *they are everywhere confined to lower levels, viz., from the shore-line up to* 120 *feet* (38 *m.*). *Above, there is none, and the line of disappearance is very marked.* My researches have extended, on the eastern side of the fjord, from the bottom to the sea; on the western side, though they do not extend so far, they go to show that the conditions there are identical with those on the eastern side. It is particularly significant that neither here are the blocks found above a height of 120 feet along the low, transverse ridge which runs from the Balsfjord on one side westwards to the Malangenfjord, and on the other, eastwards to the Lyngen and Ulfs fjords. Thus, the outer Malang isthmus, which, rising slowly to a height of 400 feet (125 m.), leads from the Bals to the Malang fjords, is along the former strewn with blocks, but only at lower levels. Above 120 feet they disappear. From this also it is clear that the inland ice cannot have moved forward across the Slet Mountain and the isthmus between the Bals and Malangen fjords, previously referred to. From the bottom of the Nordkjos, a short bye fjord of the Balsfjord, running eastwards, the Balsfjord isthmus, two miles long, with a height of 250 feet (78 m.), leads to the bottom of the Storfjord in Lyngen. Here, too, the blocks are confined solely to lower levels towards the Nord and Balfs fjords. The blocks have not reached as far as across the isthmus to the Storfjord.

The blocks may in the same manner be followed along the Ramfjord, which as a bye fjord runs from the mouth of the Balsfjord eastward to the Bredvik Isthmus. From the southern side of the mouth of the Ramfjord the Anders Valley runs in a southerly direction between lofty mountains and with a steady incline. Here, too, travelled granite blocks are found to a height of 120 feet, *but not a single one above.* The case is the same along the sounds around the town of Tromsö. Further, I have followed the blocks northwards, on the mainland to Tunnes, about five miles from the town, but whether they have travelled further along the Gröt Sound I have not yet been able to ascertain. The same applies to the Kval Sound. But researches made on the islands *outside* this sound prove beyond a doubt that the granite blocks from the Balsfjord cannot have reached these islands by way of the Kval Sound.

The greatest number of travelled blocks along the Balsfjord belong, judged petrographically, to the Divi Valley granite, blocks which might with certainty be referred to the coast granite not having been found. Along the sounds, too, the greatest number of blocks, if not all, may be referred to the Divi Valley granite; but blocks belonging to the gray, streaky gneiss-granite of the Kval Island are also met with here, some of which may even be referred to exact localities in the island. Among the rocks along the Troms Island and adjacent sounds blocks of a coarse-grained syenite are also often found. In the Divi Valley no varieties of syenite appear, but they are often encountered combined with gneiss and gneiss-granite on the coast. Although I have not yet succeeded in finding syenite in place which with certainty can be said to be petrographically identical with that of these travelled blocks, I have every reason to believe that they hail from the west.

We have now followed the course of the blocks along a continuous distance of 84 geographical miles—viz. 48 on the mainland and 36 on the shores of fjords and sounds.

From what I have advanced here as regards the blocks during their journey through the Balsfjord, it seems clear that their transport here cannot be ascribed to a moving stream of inland ice. The sharp line of demarcation, above which no blocks are found, seems in itself to demonstrate this. The line extending for miles along a long fjord and extensive sounds, and being so sharply defined, bespeaks that the transporting agency at work here must have been far more regular during a length of time than a stream of inland ice possibly could be. We have therefore every reason to conclude *that these blocks have been carried along the level of the sea on drifting ice*, [illegible]. As the block-transport appears from the first simultaneously along the long stretch of shore from the Balsfjord, and past the Tromsø Island, a strong in- and outflowing current during the diurnal tides has in all probability been at work at a period when the level of the sea was 120 feet higher than at present. And the strong drift of the ice outwards *must have been stronger than the one inwards up the fjord*. Travelled blocks of the Kval Island granite are, therefore, *not found in the interior of the fjord*, but the case is different along the broad sounds about the mouth of the fjord; here the in- and outflowing currents have had alternate sway, *and here are also found blocks of the Dwsi Valley, as well as of the coast granite*.

There is another important circumstance which beyond a doubt proves that the inland ice during the Glacial age cannot have moved along this fjord, scouring the bottom. Thus, if we consider the present depth, about 600 feet, and remember that the level of the sea during the Glacial age was about 600 feet higher than at present, and further that great quantities of *débris* must have been deposited at the bottom of the ice, it is evident that an ice stream moving through the fjord, and a sixth part of whose volume rose above the then sea-level must have reached several hundred feet above the former—that is, the unglaciating stream must have reached several hundred feet above 120 feet, the line of demarcation for the blocks, as it then lay at least 200 feet below the sea. If, however, this had been the case, granite blocks should now be found at a far greater height than 120 feet. Neither can the Balsfjord during the Glacial age have formed a valley along which the inland ice might move, as, in this case, travelled blocks would have been found along the sides at even far greater heights.

I have, therefore, after the most careful researches here, yard by yard, and extending over many years, come to the conclusion *that the Balsfjord is not of glacial origin, but formed [illegible] mountains [illegible] in the [illegible]*. And this conclusion I believe may, *in the main, apply to the question of the formation of all fjords in the north of Norway*. But whether it is applicable to all fjords *in the [illegible] of Norway* I shall not attempt to answer.

There may, however, be reason to assume that the explanation of the fjord-formation in part which have been under an earlier Glacial age as being of glacial origin, is rather based on speculation than such careful and minute researches as those I have referred to here, and which may, perhaps, contribute to prove the correct theory.

KARL PETTERSEN

Tromsø Museum

## VARIABLE STARS[1]

THIS catalogue may be regarded as complemental to the "Catalogue of Known Variable Stars," by the same author, which was read before the Royal Irish Academy, January 28, 1884. It contains a list, including lettered numbers, of 745 stars in which some change of magnitude is suspected. The stars are tabulated in order of Right Ascension for the epoch 1850.0, and in separate columns are to be found particulars of the supposed change of magnitude and the authority on which the supposed change rests. In the "Notes and Observations" by which the Catalogue is followed are given particulars of the history of each star, together with observations by the author of such stars as have received attention from him. The work is accompanied by a map showing the distribution of known and suspected variable stars.

A catalogue of this character forms a valuable working catalogue for the observer's use. By further observation suspected variation will in some cases be proved to be real, and the stars claim a place in a catalogue of known variables. A claim of this kind might indeed already be made in the case of Nos. 234, 455, and 135 of Mr. Gore's list. It may just be mentioned in passing that the place of No. 234, U Canis Minoris, is incompletely given in the Catalogue. Its more exact place for 1850 is R.A. 7h. 33m. 20s., Decl. + 9° 33'.5. There are other cases in which, though the period is as yet indeterminate, the fact of variation and its amount may be stated with some confidence. On the other hand further observation may tend to throw a doubt on the suspicion of change in the case of other stars, and, as our author observes, "these must of course be removed from future catalogues." In the notes to No. [illegible] of his Catalogue (α Hydræ), Mr. Gore quotes remarks by Sir John Herschel, Dr. Schmidt, and Dr. Gould to the effect that the supposed variability of this star may possibly be due to the influence of its ruddy colour on the estimates of its brightness. Is it not possible that the effect of colour on estimates of magnitude as respects different observers, or the same observer at different times, has hardly received so much attention as it deserves?

Large as is the number of stars included in Mr. Gore's Catalogue, further additions might be made to it. Comparing it, for instance, with the Table of Suspected Variables extracted from Mr. Chandler's unpublished Catalogue by Prof. Pickering, and printed in his "Recent Observations of Variable Stars" in the *Proceedings* of the American Academy, we find some [illegible] stars which are not included in Mr. Gore's list, and it is probable that others might be found in other quarters also. Indeed the experience of most variable star observers would probably suggest the [illegible] of slight but distinctly recognisable light-variation are relatively numerous.

A [illegible] in regard to No. 445 in the Catalogue may possibly help to avert the chance of a little confusion in the future. This star was entered as [illegible] in Prof. Schönfeld's first Catalogue of Variable Stars, but was rejected by him in his "Zweiter Catalog." There is another star called [illegible] by Mr. [illegible] in a paper in the Manchester Lit. and Phil. Soc. *Proceedings*, vol. xxi. No. 11, the place of which, brought up to [illegible], is R.A. 14h. 48m. 4[illegible]s., Decl. + 1[illegible]. This star has a period of 175.5 days, with a range of magnitude from about 13.5 at minimum to about [illegible] at maximum.

In conclusion we commend to the attention of all who are interested in the subject of variable stars a work the preparation of which must have entailed on the author a considerable amount of labour both as compiler and observer.

[1] A Catalogue of Suspected Variable Stars, with Notes and Observations, by J. E. Gore, M.R.I.A., F.R.A.S. A paper read before the Royal Irish Academy, [illegible].

## NOTES

A [illegible] announce the [illegible] death of Dr. Emil Riebeck, at Feldkirch, where he was preparing for another five years' journey. Our first review in this week's NATURE refers to some of the last results of Dr. Riebeck's journeys. Either directly or indirectly he has done good work for science in [illegible] parts of the world. He was a liberal patron of explorers, [illegible] recent researches of Dr. Schweinfurth, in Socotra, for example, were carried out at Dr. Riebeck's expense. His death [illegible] serious loss to science.

The death is also announced, at the age of sixty-seven years, [illegible] Mr. W. S. W. Vaux, F.R.S., the well-known numismatist [illegible] Oriental scholar, and Secretary to the Royal Asiatic [Society].

We have still another death to record this week—that of M. [illegible] Tresca, an eminent French physicist and mechanical [engi]neer. He was born at Dunkirk in 1814. He studied at the [Poly]technic School, and on leaving it entered the corps [illegible] [Ponts] et Chaussées, but soon afterwards quitted the service in [order] to devote himself to scientific study. In 1850 he was [appo]inted principal inspector of the French Section of the [Exh]ibition at London, and afterwards became sub-director of [the] Conservatoire des Arts et Métiers, and he there filled with [illegible] distinction the Chair of Industrial Mechanics. In 1872 [he] was elected a Member of the French Academy. Of his [numer]ous works may be mentioned his "Cours de Mécanique [illegible]" and his "Écoulement des Liquides." The Academy of Sciences, on hearing of his death from the President [on Mon]day, closed the sitting as a mark of grief.

[W]e are informed that Dr. Barius, Surgeon-General to the [French] army in Tonquin, died on the 10th in Haiphong after a [illegible] illness caused by overwork and anxiety in that unhealthy [climat]e. Dr. Barius is well known to the scientific world [illegible] [meteor]ological writings, especially his able and exhaustive [Re]cherches sur le Climat du Senegal. While in Haiphong [illegible] took the trouble to make observations every [illegible] and 4 p.m., which he reduced and forwarded [illegible] and his loss is severely felt [illegible] [h]e mentioned in a letter that [illegible] which he had urged the necessity, would [illegible]

[illegible]

[At t]he Oxford Commemoration last week, the honorary [degree o]f D.C.L. was conferred upon Prof. Huxley.

[The] organising committee of Section A of the British Association have arranged for the following [illegible] [m]eeting:—[illegible] Kinetic [illegible] [illegible] of White Light. [illegible] [illegible] take part in the [illegible] of Section A [illegible] meeting to the Reception [illegible]

[The C]ouncil of the Society of Arts have awarded the [illegible] [med]als to the following [illegible] [188]4-85:—To Anton [illegible] [illegible] of Batteries. To [illegible] [illegible] and Prospective Sources of the [illegible] [illegible] To A. J. Ellis, B.A., F.R.S., for [illegible] [M]usical Scales of Various Nations. [illegible] his paper on "Recent [illegible] British [illegible] for his paper on [illegible] District. [illegible] in the Kilimanjaro [illegible] on "The Agricultural Resources [illegible] M. Bhownaggree, for his paper on [illegible] Education in [India] and Future Prospects of Female [illegible] [Fr]ederick Siemens, for his paper on "[illegible] [Fred]erick J. Lloyd, for his paper on [illegible]

[Fro]m details that have reached us in the [illegible] [illegible] Clifton Hall [illegible] [illegible] are to be relied upon [illegible] in which the great explosion appears to have [illegible] 140 men and boys, appears [illegible] the same time very free from [illegible] whether those who investigate the [illegible] give due weight to the now [illegible]

[illegible] instead of burdening themselves with putting forward [illegible] [guess]es and assumptions, which, it is [illegible] have usurped the place of those careful and exhaustive methods of inquiry and deductive reasoning that are [illegible] with the apparent mystery in obscure [illegible]. It is noteworthy that this explosion has occurred in the [illegible] district in which shotfiring is supposed to [illegible] prohibited except when the workmen are [illegible] and it will be a curious commentary upon the [illegible] of the Home Office [illegible] rule of [illegible] the other mining districts of the country, [illegible] that the explosion in question was not originated by a [illegible] some other cause, such as the ignition of [illegible] the result of the [illegible] with very [illegible].

Mr. J. R. Henderson, M.B. Edin., F.L.S., [illegible] of the [illegible] Edinburgh, has been appointed Professor of Biology in the Christian College, Madras. This, we understand, the first Professorship of Biology which has been founded in India. Mr. Henderson had a very distinguished career in the University, being awarded, among other [illegible] [illegible] Gold Medal. He is at present [illegible] the Arctic [illegible] Expedition.

[illegible] of the University of Columbia, has [illegible] in connection with the United States [illegible] important [illegible] the [illegible] of the Cameroons, [illegible] [illegible] regarding [illegible] The high-class [illegible] [illegible] of the [illegible]

[illegible]

carried away by the torrent. From the reports it appears that the eruption of Semeru was accompanied by volcanic disturbance all over the western part of Java. A mud spring, or rather lake, bubbled up into the Preanger, in West Java; a volcano, Slamat, lying west of the Merapi [illegible], has manifested signs of renewed activity, as has Klut, farther to the east. Lamongan, lying still farther eastward, throws out showers of ashes, and in Kema, an island near Timor, mud has issued from the side of a mountain, and has overflowed a district described by the natives as twenty minutes' journey in breadth.

M. Gaston Tissandier [illegible] on Friday, June 20, in a balloon with a photographic apparatus to take instantaneous views. Not less than twenty-four [illegible] on the trip, which began at 2 o'clock [illegible]. The departure took place at Point du Jour (Paris), [illegible] in the vicinity of Rheims.

Mr. R. Anderson, F.C.S., has in the press a new and enlarged edition of [illegible] "Lightning Conductors: their History, Nature, and Mode of Application." Messrs. Spon are the publishers.

Mr. Morris, [illegible] of Jamaica, delivered an address before the [illegible] Institute [illegible] on the scientific work done, and still to be done, [illegible], more especially in the local museum. The [illegible] in course of formation, [illegible] years there have been brought together [illegible] fishes, [illegible], shells, and an illustrative [illegible] of other [illegible] products. The geological [illegible] plants and useful [illegible] and character of the [illegible] contents, and [illegible] the nature and [illegible] of building stones, &c. The collection of [illegible] about [illegible] specimens [illegible] can be regarded as complete. The [illegible] of Jamaica, Mr. Morris says, are [illegible] known [illegible] excellently [illegible] ago the fish [illegible] Washington Museum. [illegible] the local museum has [illegible] a collection [illegible] already [illegible] been [illegible] inherent [illegible] have been [illegible] and [illegible] Mollusca [illegible] known [illegible] Jamaica [illegible] which is [illegible] the whole world. The [illegible] in [illegible] hoped [illegible] a good collection of the medicinal and [illegible] plants. [illegible] which we have [illegible] Mr. Morris [illegible] on the [illegible] complete [illegible] like London. There is no lack of [illegible] purposes, and systematically arrange [illegible] such a state [illegible] due and proper [illegible].

In the [illegible] days of August next an International Botanical and Horticultural Congress will be held at Antwerp. Amongst the questions which will be proposed for special consideration is the flora of the new Congo Free State, the methods of [illegible] already existing there, and the possibility of acclimatising new plants. The committee appointed to carry out the preliminary arrangements for the Congress has drawn up a series of questions, which, with the help of the Association Internationale Africaine, has been sent out to the Congo for replies. A special sitting will be devoted to this subject, and a herbarium of the principal flowers and plants of various neighbourhoods in the State and a collection of fruits and seeds will be accessible to members. The queries sent to the Congo refer to the nature of the soil; the maximum and minimum temperatures; the climatic conditions, the conditions favourable to cultivation, and those which are unfavourable; the food, medicinal, poisonous and [illegible] plants; the help which Central Africa offers to botanists for the study of tropical flora and physiology; the cultivation of vegetables on the Congo; the principal enemies of cultivation in the vegetable and animal kingdoms; and the best mode in which botanists and gardeners can utilise the labours of the Congo explorers. Like other [illegible] Congresses the International Botanical and Horticultural Congress this year will apparently be mainly occupied with questions relating to Mr. Stanley's new State.

We have received from Mr. F. W. Putnam, the Curator of the Peabody Museum of American Archæology and Ethnology, two papers by him [illegible] of the pine grove or forest [illegible] shell-heap, near Salem [illegible] remarks on chipped stone implements, which we noticed on their appearance in the [illegible] of the Essex Institute.

Mr. J. Macdonald Cameron has prepared a report on the [illegible] of the Commissioners of [illegible] of Bahia in Brazil. In addition to the [illegible] of this [illegible], there is much interesting information with regard to the [illegible] of these [illegible]. Mr. Cameron [illegible] of the mangroves on the [illegible] swamps in the [illegible]. The dirty [illegible] in which the mangrove vegetation is very [illegible] the [illegible] in England the rivers and [illegible] the banks of which [illegible] works are situated. He [illegible] the opinion that the mud is principally formed by [illegible] decomposition of the roots and branches of the mangrove [illegible]. The [illegible] and flow slowly, and [illegible] the mud. The abundant food for the [illegible] material for [illegible].

We [illegible] of the Hastings Microscopical and Natural History Society for the past year. Mr. Greenhill's paper on [illegible] is of much interest, although the title [illegible] under[illegible]. Mr. Greenhill has [illegible] which he has found in [illegible]. 2) [illegible] paper is to [illegible] of these three [illegible] of the [illegible] were not formed till long [illegible] is a [illegible] the characteristics, [illegible] who attend [illegible].

The Annual Report of the [illegible] Natural History Society [illegible] flora of the county [illegible] work will shortly be ready [illegible] of the past two years have [illegible] and Characeæ [illegible] by Mr. [illegible] are being [illegible] other parts of the county. The [illegible] few in number, [illegible] not represent the work of the Society. A course of village lectures on scientific subjects has been carried out with success.

[In] a paper read at the last meeting of the Librarians' Association, Mr. J. R. Boosé describes the progress of Colonial public libraries. Commencing with those in the Dominion of Canada, [he] stated that as far back as 1779 there was a public circulating [librar]y at Quebec. He then traced the progress of the public [librar]y system up to the present, giving a detailed account of [the P]arliamentary Library at Ottawa, and also referring to the establishment of free public libraries. He then traced [the p]rogress made in the Australasian colonies, dealing separately [with t]he libraries of Victoria, and stated that the [illegible] [of t]he libraries in those colonies only dated from the [illegible] of the present century. Their growth, however, had [been] extraordinary rapidity; the statistics for Victoria [illegible] [th]ere were 143,073 volumes in the public library [illegible] 317,205 in the libraries of the colony, and that [illegible] [illegible] were visited in 1883 by 3,100,000 persons. Mr. [Boosé] after describing the libraries of the other [illegible], referred to those of the Cape Colony, Natal [illegible] British Guiana, Trinidad, the Bahamas, [illegible] [illegible], observed that it was a truly [illegible] [illegible] of these institutions, [illegible] collections of books, every [illegible] such valuable works of reference [illegible] [purc]hased privately, and were only [illegible] recognised status. He thought [illegible] Governments should provide [illegible] maintenance, and not throw the cost [illegible] [loca]l authorities.

[illegible] Zoological Society's [illegible] include two Bonnet Monkeys [illegible] presented [illegible] Farrall; two Common Marmosets [illegible] presented by [illegible] from [illegible] two [illegible] by Col. C. [illegible] from North [illegible] two Partridges [illegible] J. Snelgrove; [illegible] a Pleasant [illegible] Africa, [illegible] North Africa, purchased [illegible] Carolinian Beaver [illegible] bred in the Gardens.

## OUR ASTRONOMICAL COLUMN

[illegible]

*Occultations of Stars by the Moon*

| Date | Star | Mag. | Disap. | Reap. | Corresponding angles from vertex to right for inverted image |
|---|---|---|---|---|---|
| | | | h. m. | h. m. | ° ° |
| 30 | 11 Capricorni ... | 6 | 0 0 | 1 7 | 119 259 |
| 30 | 14 Capricorni | 5 | 1 36 | 2 22 | 153 253 |
| July | | | | | |
| 2 | B.A.C. 7774 | 6 | 2 37 | 3 59 | 93 302 |

*Phenomena of Jupiter's Satellites*

| June | h. m. | | June | h. m. | |
|---|---|---|---|---|---|
| 29 ... | 20 26 | I. tr. ing. | 2 ... | 22 35 | III. occ. reap. |
| | 22 40 | I. tr. egr. | 1 | 20 28 | IV. ecl. reap. |
| 30 | 20 56 | I. ecl. reap. | | | |

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

July 3, 23h. — Venus at greatest distance from the Earth, the distance being one sixtieth part greater than the mean distance.

## GEOGRAPHICAL NOTES

THE Royal Geographical Society have decided to send out another African expedition. This time the region to be explored is one of more than usual interest, and the method of procedure will be considerably different from that which has been hitherto usually followed. We have had many lines run through Africa in all directions, and what is now needed is the leisurely study of the continent in detail. This is what will be done by the expedition which will leave England in August next, under Mr. J. T. Last, who, as a lay agent of the Church Missionary Society, has done admirable work in the Zanzibar interior. Mr. Last, after making up his caravan at Zanzibar, will proceed south to Lindi, to the mouth of the north of the Rovuma River. Thence he will proceed to the confluence of the Rovuma and Lujenda Rivers, and fix the longitude of the confluence, an important geographical point not yet settled. He will then go on in a generally south-westerly direction, and, before reaching the south end of Lake Shirwa, turn southward and make for the Namuli Hills, which, with other new features in the region, were discovered by Consul O'Neill in the year 1883. Here Mr. Last will establish himself and make a detailed study of the whole region in all its aspects. He will make a complete survey of the surrounding country, its topography, its people, its fauna, economic products, climate, and languages. When this is completed Mr. Last will enter the valley of the Lukugu River, which rises in the neighbourhood of these hills, and follow it down to the coast at Quilimane, whence he will travel south to Quilimane or north to Angoche, and thence to Mozambique. Mr. Last will make a special point of collecting all possible information concerning the country he passes through, its changes; its people, their customs, [illegible]; the climate, its sanitary conditions, and its suitability for the introduction of European and [illegible].

THE last number of Petermann's *Mitteilungen* [illegible] the conclusion of Herr Schonlank's account of [illegible] and the [illegible] Cape Colony [illegible] the German [illegible] also with a map, by Herr Langhans [illegible] Costa Rica, by Dr. Polakowsky [illegible]. It is a [illegible] and [illegible] Costa Rica by Dr. Thiel [illegible] for science that this [illegible] his flock and whose thirst for [illegible] remarkable, should have been [illegible] by the [illegible] Government, and that in such [illegible] leave behind him all his journals, [illegible] &c. He travelled and lived [illegible] among the various tribes of Indians, and studied the [illegible] the [illegible] and ethnology of the country. He is at present visiting the eastern coasts of Nicaragua and Honduras in order to collect Indian antiquities and the remnants of Indian languages. The same paper also contains a report of a journey in Costa Rica by Padre Fernandez.

A CORRESPONDENT writes to *Ausland* from Santiago to correct a mistake as to a reported discovery of a glacier in Chile. The glacier in question is called the A[illegible] glacier, and occupies the upper end of the Cañon de los Cipreses, a branch of the valley of Cachapoal. In a note which appeared in the fourth number of *Ausland* this year and was copied from the *Proceedings* of the Royal Geographical Society, the discovery of this glacier was attributed to Dr. Güssfeldt. Some years previously the same discovery had been ascribed to Mr. Charles Wiener. The fact is, the correspondent states, the glacier has been known to the visitors to the baths of Cauquenes for the last twenty years at least. MM. Wiener and Güssfeldt, like other visitors to the baths, had had their attention called to it, and each in turn was consequently credited with its discovery.

THE French Minister of Public Instruction has published a report which he has received from M. Chaffanjon, a professor in Guadeloupe, giving an account of his mission on the Orinoco. In order to investigate fully the hydrography of the river he has often found it necessary to travel far away from the banks on both sides, and he has thus been able to survey the former beds. He has also obtained the materials for a geological map of the region and for a description of the phenomena attending the formation of this part of the earth's crust. Hitherto we have had only vague ideas respecting the Indian races, because they were without history or ancient remains. Prof. Chaffanjon has discovered at five different places inscriptions and pictures in granite, which he has carefully copied. He has collected a crowd of ethnological objects amongst the Caribs, the Panares, and the Mapoyes. He hopes also to be able to fill certain gaps in the zoological and botanical collections in the Paris Museum. The report is accompanied by a sketch on a scale of 1 to 600,000 of the course of the Orinoco between Caicara and Ciudad Bolivar, which gives a considerable number of names new to geography.

THE Berlin Geographical Society has decided to erect a monument at the burial place of the late Dr. Nachtigal, at Cape Palmas, and all Germans are invited to send contributions to the fund for the purpose.

## ELECTRICAL DEFINITIONS, NOMENCLATURE, AND NOTATION[1]

WITH the rapid progress that has lately been made in electrical science and its applications, there has sprung up a new and fast increasing class of practical electricians. These, partly from necessity and partly from well-meant respect, have [illegible] and applied the old terms and expressions which were [illegible] to their predecessors, as well as coined not a few new ones, until now their vocabulary is in considerable confusion, and, as all must admit, requires sifting and reform.

Nothing is more tantalising and perplexing than the different modes of expression and symbols used by different authors, and sometimes by the same author, to explain and interpret one and the same thing or result. All this might be avoided if an international system of definitions, nomenclature, and notation was agreed upon and [illegible]. The rapidity with which the new definitions of the ohm, ampere, and volt [illegible] and legalised [illegible] by the International Congress of Electricians were [illegible] adopted, [illegible]. These definitions should be still further extended to other electrical units. There should [illegible] a [illegible] system of notation, whereby electricians could represent magnitudes and letters, terms, expressions and formulæ of [illegible], in a similar manner to that adopted by chemists in connection with chemical elements and their combinations. [illegible] the author [illegible] a communication to the Society on this subject, and, being again reminded by the [illegible] of his unfulfilled promise, he now submits a few of the more [illegible] instances where ambiguity or want of uniformity exists, with suggestions, in the hope that discussion may follow, and that a committee of the Society may be formed to consider and draw up a series of definitions, nomenclature, and notation that would be generally acceptable. The proposed Committee might then confer with the French Committee, along with a similar Committee appointed by the British Association, and, finally, the important question should be referred to the International Congress of Electricians, in order that they may legalise and issue their decisions in a similar manner to that adopted by them in the case of the ohm, the ampere, and the volt. Undoubtedly, if such a course were adopted, most beneficial results would accrue to all concerned.

[1] Paper read before the Society of Telegraph Engineers and Electricians, on May 14, 1885, by Prof. Andrew Jamieson, C.E., F.R.S.E., Member, Principal, College of Science and Arts, Glasgow.

...ly last November M. Hospitalier brought this subject ...ently before the International Society of Electricians ... and strongly advocated an investigation, so that you shall ... have their support and concurrence.

*Examples.*—(1) At the very outset students are perplexed by ... different terms as "Ordinary" or Static or Frictional ... tension Electricity." One author will tell his readers ... "For a long time the name Frictional Electricity ... to a group of phenomena produced by electrical ... is an improper expression, because friction ... for producing electrical charges." Another ... Electricity is, however, a misnomer; ... all the phenomena are due to static strain ... a gradual loss called leakage, which ... due to the actual conductivity of all circuits ... set up by so-called static electricity ... field of force ... and action occurring in a ... inductive circuit in which ... in the particular inductive circuit ... A third objects to the word "tension" ... and points out that "all the phenomena ... Electricity ... with so-called High-tension ... drawn from batteries or dynamos ... by electricity drawn from batteries ... force or difference of potential ... "Electro-static" ... Would not the term ... and comprehensive?"

The old nomenclature "vitreous" and "resinous" ... to substances which, when rubbed ... produce opposite electrical properties ... two-fluid theories ... more comprehensive modern theory ... of molecules ... continuous ... or by the algebraical ... and "negative."

"Electrics," "dielectrics," "non-conductors," ... and "isolators" are terms used by ... a condition or behaviour of certain ... to the term ... in contradistinction to other materials ... "conductors" as applied to other ... "non-conductors," ... meaningless, because all materials ... and all conductors only ... "isolators" and "insulation" ... isolate or separate) should give way ... insulation" as applied to electricity ... greater resistance ... used in connection with the ...

"dielectric" was first used by ... induction was effected by ... generally employed ... molecules, and ... inductive ... when speaking of the conduct ... surrounding ... placed between ... cables, or that ... of a body ... in this sense ... capable of undergoing ... condition, it is a very ...

(4) The term "accumulator" is the name given in several text-books to apparatus, such as the Leyden jar or condenser, for receiving and retaining quantities of electricity, but has been lately inappropriately applied to secondary batteries, which do not accumulate electricity.

(5) "Cascade," as applied to Leyden jars, should give way to "series."

(6) "Tension," "potential," and "electro-motive force," are terms which, when variously and indiscriminately applied, have given rise to considerable confusion, and a great deal of ... If we consider "tension" ... simply the ... in the circuit by the electro-motive force, and not in the sense ... employed, for example ... it might ... very well ... can easily be ... given great trouble.

We find in Sprague's "Electricity" ... more than three pages ... the different ways in which the ... Clerk Maxwell ... generally ... journal." ... of electrical ... no longer ... Professor Fleming ... twenty-six pages ... of potential or ...

call s the "declination." Variation is, properly speaking, the hourly, diurnal, annual or secular changes which occur in the values of the elements of terrestrial magnetism. This leads to great confusion and argument between the electricians and the officers of a telegraph steamer. The declination for each place is marked on the Admiralty charts. Sailors also speak of the [illegible] is the resultant of the [illegible] and heeling error, &c. [illegible] Sir William Thomson [illegible] of "declination." [illegible]

(10) When [illegible] we find the [illegible] &c. [illegible]

(10) "[illegible] [illegible]

11. "[illegible] [illegible]

[illegible]

12. Again, we have the two different ways of graphically representing a battery

[illegible] Practical submarine [illegible] the first to [illegible] handy way of representing a battery and [illegible], and always adopted the former method, with the long thin vertical line for the plate where the current [illegible], and the thick short line for the plate where the current [illegible] to the battery. Why should this have been deviated from? It is a very arbitrary arrangement, but, being a [illegible] symbol, it should be used in a uniform manner. Mr. John Munro proposes that the symbol for a secondary battery should be a modification of this, viz.:—

the current [illegible] to the [illegible] to the [illegible]

13. "[illegible] [illegible] currents, [illegible]

14. "Polarisation" [illegible] [illegible] Kerr experiments. [illegible]

15. [illegible] and [illegible] lighting, [illegible] different [illegible] [illegible]

[illegible] throughout, except in such cases [illegible] that [illegible] from some other author.

It will be observed in this list that in most [illegible] the first [illegible] or Greek letter of the word has been used. Those [illegible] the metric system have been copied from the French [illegible] Hospitalier's "Electrician's Pocket-book," which [illegible] copied from the list decided upon by the International [Comm]ission on the Metre, with a few omissions [illegible] the author.

[The] Greek letters π, μ, e are universally adopted for [the rati]o of the circumference of a circle to its diameter, [the co]efficient of friction, and e for the base of Napierian [logarit]hms.

*Metric Abbreviation.*

| | | |
|---|---|---|
| m. | for | metre. |
| cm. | ,, | centimetre. |
| mm. | ,, | millimetre. |
| [illegible] | ,, | metre square. |
| [illegible] | ,, | [illegible] |
| [illegible] | ,, | centimetre square. |
| [illegible] | ,, | centimetre cube. |
| [illegible] | ,, | gramme. |
| [illegible] | ,, | milligramme. |
| [illegible] | ,, | kilogramme. |
| [illegible] | ,, | kilogrammetre. |
| [illegible] | | &c. |
| [illegible] | ,, | temperature. |
| [illegible] | ,, | [illegible] |
| [illegible] | ,, | gramme-degree. |
| [illegible] | ,, | kilogramme-degree. |

[illegible] *Letters* [illegible], *Numerals, and Signs.* [illegible]

[illegible] letter [illegible] used for the [illegible] with suffixes 1, 2, 3, [illegible] [illegible] as a whole. For example, L [illegible] for different lengths [illegible]

*[Fun]damental and Derived Mechanical [Units].*

| | | |
|---|---|---|
| [illegible] | for | Length. |
| [illegible] | ,, | Mass. |
| [illegible] | ,, | Time. |
| [illegible] | ,, | Velocity. |
| [illegible] | ,, | Acceleration. |
| [illegible] | ,, | Force [illegible] |
| [illegible] | ,, | dyne [illegible] |
| [illegible] | ,, | Work. |
| [illegible] | ,, | weight. |
| [illegible] | ,, | foot-pound. |
| [illegible] | ,, | Horse-power [illegible] |
| [illegible] | ,, | Indicated [illegible] |
| [illegible] | ,, | Brake [illegible] |

[illegible]

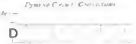
[illegible]

*Electrical Units.*

[illegible]

*Dynamo Circuit Connections*

Example:—



| | | |
|---|---|---|
| D | for | Dynamo |
| T. [illegible] | " | Terminal positive. |
| T. [illegible] | " | Terminal negative. |
| E.M. | " | Electro-magnet. |
| F.M. | " | Field Magnet. |
| [illegible] | " | candle-power of a lamp. |
| A.M. | " | Ampere-meter. |
| V.M. | " | Volt-meter. |
| S.W.G. | " | Standard wire gauge. |

*Letters in Formulæ.*

| | | |
|---|---|---|
| R. R. R. | " | Resistance of armature, magnets, and external circuit respectively. |
| C. C. C. | " | Current in armature, magnets, and external circuit respectively. |
| L. | " | coefficient of self-induction. |
| L. | " | coefficient of mutual induction. |

In the above notation the first letter of the most important words has been used whenever it was found practicable to do so, and the recurrence of the same letter under similar circumstances avoided as much as possible. In cases where no ambiguity can occur, such as H for the heat in Joules, and H for the horizontal intensity of the terrestrial magnetism, m for metre, and m for magnetic strength of pole; V for velocity, and v for volts, it will be observed that the same letters appear in each case.

M. Hospitalier, the Secretary of the French Committee on this subject, came over from Paris specially to take part in the discussion, and related what had already been done by him in Paris.

Prof. Forbes, Mr. John Munro, Prof. Ayrton, Dr. Fleming, Prof. Hughes, Prof. Silvanus Thompson, and others took part in the discussion, and generally agreed that a uniform system was much required. The paper, they said, had given a very fair start to the [illegible].

The author replied that he was glad the Society had agreed so readily to form a thoroughly representative committee, and hoped that their work would be not only speedily accomplished but satisfactory to all interests.

## THE JUBILEE OF THE STATISTICAL SOCIETY

THE Statistical Society has been holding a [illegible] during the present week in celebration of the jubilee of its foundation. The meeting is really an International Congress of Statistics, some of the most eminent foreign statisticians being present as the guests of the Society; among others Sig. Bodio of Rome; MM. Keleti, Körösi, and [illegible] of Buda-Pesth; Prof. Levasseur and M. de Foville, of France; Gen. F. A. Walker, of the United States; [illegible], and others. The meetings have been held in the theatre of London University, and several subjects of much statistical importance have been introduced for discussion. One of these was the claim of statistics to be considered as a science, discussed at some length in the address of the President, Sir Rawson W. Rawson. Statistics, as usually treated in this country, is little more than the mere calculating of numbers, is a mere mechanical operation; but when treated as some of the most eminent statists have treated it, as dealing with the structure of human society, then it certainly becomes amenable to scientific methods. Sir Rawson Rawson referred further to the want of organisation in the collection and publication of official statistics in this country, and rightly advocated reform in this respect. Among the other papers read on Monday were—a sketch of the history of the Society, by Dr. F. J. Mouat; "Statistical Developments, with special reference to Statistics as a Science," by Dr. W. A. Guy, F.R.S.; and on "Statistics and their Enemies," by M. de Foville. One of the principal papers on Tuesday was by Mr. R. Giffen, on "Some General Uses of Statistical Knowledge," in which, among other things, he referred to the rapid increase of the population of Europe during the last century as compared with the increase in China and other Asiatic countries (except India) and in Africa. Should the present rate of European increase continue, the population of our continent in another century will be 1000 millions, while that of the United States would be 500 millions. Mr. Giffen maintained that the increase in Europe had been accompanied by a corresponding increase in the means of subsistence and improvement in the position of all classes.

Mr. J. S. Jeans read a paper "On Uniformity of Statistics." He held the chief *desiderata* required with a view to the improvement and co-ordination of the statistical work undertaken by different Government bureaux were: (1) an agreement as to the major facts necessary to be collected for each special department of statistics; (2) uniformity in the processes by which these facts were got together; (3) co-ordination of the methods whereby the materials thus collected were systematised and made use of; (4) the adoption, as far as possible, of the calendar year as the universal statistical period, so that when comparisons were made they should always relate to the same dates; (5) the general adoption of the metrical system of weights, measures, and currency.

Herr Körösi spoke "On the Unification of Census Record Tables." The voluminous and polyglot census results of the world were, he found, practically non-comparable, and he proceeded to sketch a uniform scheme of record tables by which we should arrive at one [illegible] at the highest aim of statistics—the possession of a uniform description of the different nations and of all mankind as regarded sex, age, civil state, illiteracy, occupations, &c.

Mr. F. Y. Edgeworth, in a paper entitled "The Methods of Statistics," confined himself to the treatment of numerical means. He showed that if we take several means of phenomena belonging to one and the same class (e.g. stature of men), each mean derived from numerous observations, the [illegible] of values thus presented would in general fulfil a certain simple mathematical law. The general formula involved a constant or coefficient peculiar to each class of phenomena, which must be discovered by experience. When this operation had been performed we had an apparatus for testing whether any given mean was [illegible] indicative that the set of things of which the mean was the mean might be compared with other phenomena of the same general [illegible] regarded as belonging to a different [illegible]. A pretty illustration of important principles was afforded by the [illegible] of a wasps' nest, "the [illegible] which were encountered coming from their nest [illegible] that the exports and imports of this [illegible] with mathematical regularity. [illegible] of the variety of interests amenable to [illegible] the attendance of the members of [illegible] and the frequency of [illegible] in the [illegible]. The conditions postulated by the Calculus of Probabilities were [illegible] well exemplified in the [illegible]. In conclusion he alluded to the [illegible] and maintained that the mathematical [illegible] with the more elementary [illegible] could [illegible] with less trouble, or, with the same trouble, greater [illegible].

M. [illegible], Member of the Institute and Professor at the Collège of France, made a [illegible] on the graphic method applied to statistics, exhibiting diagrams and cartograms [illegible] illustrating his views. Prof. Marshall, of Cambridge, [illegible] the use of a standard [illegible] in order to simplify reference to the [illegible], and pointed out dangers in the [illegible] arising from their deceptive appearance [illegible]. He suggested a ready means of testing the [illegible].

[illegible] was mainly occupied by a conference and discussion on the subject of an International Statistical Institute, the establishment of which was virtually agreed to.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—At the annual election at St. John's College on June 22, the following awards were made to students of Mathematics, Natural Science, and Medicine:—

Foundation Scholarships.—Mathematics: Love, Fletcher, [illegible] raised to 100*l*.), Bushe-Fox, Kirby, Mossop, [illegible] Hill [illegible] Natural Science and Medicine: Shore, Rolleston, Seward [illegible]. Exhibitions.—Mathematics: Holmes, Middlemast, [illegible] [illegible] Bushe-Fox, Foster, Flux. Natural Science [illegible] Rolleston, Olive, Jones. Natural Science: [illegible] [illegible] Lake.

[illegible] Scholarships.—Mathematics: Norris, Varley [illegible] Prizes.—Mathematics: Love. Natural Science [illegible]

Wright Prizes.—Mathematics: Fletcher, Bahr, [illegible]

Herschel Prize (for Astronomy).—Bushe-Fox.

[illegible] Prize (for Electricity).—Not awarded.

[illegible] Hutchinson Studentship (NATURE, May 28 [illegible]) [illegible] to Dr. Rapson (First Class, Classical Tripos 1883 [illegible]) Indian Languages Tripos 1885) to assist him in the [illegible] of his studies in Sanskrit literature.

[illegible] next Adams Prize will be adjudged in 1887. The [illegible] Ellipsoidal and Spheroidal Harmonic Analysis [illegible] particularly drawn to the reduction of the [illegible] to practical forms adapted to numerical [illegible] with the exception of spherical harmonics, the [illegible] remained almost barren in physical investigation [illegible] [illegible] of its utility are invited. The essay [illegible] December 16, 1886, and any Cambridge graduate may [illegible]. The successful candidate will receive [illegible]; he [illegible] the essay at his own expense.

[illegible] Mathematical Board recommend the [illegible] be appointed for the final portion of the M[illegible] in the hope of inducing more [illegible] and specialists to undertake the [illegible]

[illegible] Annual Report of the Observatory [illegible] [illegible] of progress. Among the 325 [illegible] [illegible] were 2442 of zone stars on [illegible] at five or seven wires, and all [illegible] The reductions of observation [illegible]

[illegible] Botanical Gardens during the past year the [illegible] [illegible] plants has been greatly improved [illegible] rare species have flowered [illegible] [illegible]. A speciality has been made of [illegible] from this garden have been figured [illegible]

[illegible] not exceeding 100*l*. is to be made [illegible] College [illegible] R., of Gonville and Caius College [illegible] Scholars Fund, to enable him to [illegible] the experiments now being [illegible] as a preventive against [illegible]

## SCIENTIFIC SERIALS

*Journal of Botany* for May and June [illegible] continues his paper on [illegible] new species [illegible] illustrated. Several new [illegible] *Diplocecium* [illegible] identifies *Bacterium* [illegible] of the [illegible] profuse sweating of [illegible] Mr. H. N. [illegible] micrococcus of [illegible] to the British [illegible] and Mr. H. N. [illegible]—Mr. R. D. Fitzgerald and Rev. R. S. [illegible] new Orchids [illegible] from the [illegible] *Pendarrigenia* [illegible] some notes on the [illegible] contributes notes on [illegible]

*Scientifica Industriale*, May 15 [illegible] after-glows (continued), by [illegible] thermicity of [illegible] associated with [illegible] the electric resistance (concluded), by Prof. [illegible] to the temperature [illegible]

*[illegible] l'Académie Royale de Belgique*, April [illegible] on some specimens of calcite [illegible]—Note on the [illegible] of Blaton.—[illegible] whales (*Balaena* [illegible]) by M. P. J. Van Beneden [illegible] by M. [illegible] Mosasaurus [illegible] a gigantic [illegible] near [illegible] Mesvin-Ciply [illegible] Riccati's equation [illegible] Tilly.—State of the [illegible]

March at Liège and [illegible], Belgium, by Baron [illegible] Selys Longchamps.—On the presence of Condroz graywacke in the neighbourhood of [illegible] [illegible] at Meuse, by M. Michel Mourlon.—[illegible] by M. A. [illegible] a modification [illegible] by M. P. [illegible].—The Roman [illegible] in the Middle [illegible] public, by M. A. D[illegible]

## SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18.—"The [illegible] of Tidal Streams [illegible] of Salt and Fresh Water. Experimental Research, Part II [illegible]." By Thomas Andrews, F.R.S.E. Communicated by Prof. G. G. Stokes, Sec. R.S.

[illegible] Electromotive Force during [illegible] on Tidal Streams [illegible] Proc. Roy. Soc., No. 231, the [illegible] part of this investigation. The [illegible]

[illegible]

Geological Society, [illegible]

[illegible]

peninsula—in the neighbourhood of Clynne [illegible] of Aberdeen. Lastly, he describes a very remarkable [illegible] boulder, discovered by Dr. Hicks, which rests on [illegible] rock at [illegible] near St. David's. [illegible] (South African Geology) No. 2, a sketch of the gold fields of the Transvaal, South Africa, by W. H. Penning, F.G.S. [illegible]

[illegible]

**Royal Meteorological Society**, June 17.—Mr. R. H. Scott, F.R.S., President, in the chair. [illegible]

[illegible]

Lieut. A. Keeper, R.N. [illegible], by Mr. H. Cunninghame, M.Inst.C.E., F.R.Met.Soc.

**Geologists' Association**, June 5.—Wm. Topley, F.G.S., President, in the chair.—A paper was read by Mr. Herbert Goss, F.L.S., on some recently discovered Insects and Arachnids from [illegible] Rocks. The author stated that in 1870 only 103 [illegible] from the Carboniferous rocks of the whole world were known, but during the last five years [illegible] about 1400 [illegible]

[illegible]

[illegible]

**Royal Society** [illegible]

[illegible]

PARIS

**Academy of Sciences**, June 15.—Note on MM. Paul and Prosper Henry's [illegible] for photographing the heavenly [illegible], by M. Mouchez. The author presented to the Academy the already executed chart of a section of the Milky Way, including [illegible] from the sixth to the fifteenth magnitude comprised in the space between 2° 15' right ascension and 3° declination. To complete the representation of the [illegible]

[illegible] of the firmament there will be needed [illegible] forming 1500 of our ecliptical charts. Were the work taken by six or eight observatories well situated in the [illegible] [illegible]heres, the whole might be concluded in [illegible]

Such a work, containing the photographs of [illegible] down to the 14th or 15th magnitude, [illegible] to future astronomers an exact picture of the [illegible] at the close of the nineteenth century, would [illegible] most astronomical undertaking ever [illegible] [illegible] of the various [illegible] and [illegible] physical geography and the geology of the globe, by M. [illegible]—Remarks on M. Alfred Grandidier's [illegible] of Madagascar, completing the third [illegible] great work on the "Physical and Political History [illegible]," by M. Alph. Milne-Edwards.—[illegible] part of the Map of Algeria [illegible] second and third sheets of the [illegible] of [illegible] the Academy by M. [illegible] on the diphtheric [illegible] of [illegible] of Palisa's new planet 248 [illegible] equatorial of the west tower [illegible] of the same planet [illegible] 50 in. telescope, by M. [illegible] of the [illegible] gradually [illegible] spectroscopic observations [illegible] matter; mutual [illegible] by M. William [illegible] presented during [illegible] [illegible]

[illegible]

an objective tube containing a lens and a diaphragm turned towards the source of light with two slits lying above each other, a prism for decomposing the two bundles of incident rays, and a second collimator tube, on the lid of which during the end appeared two spectra showing an interval between them. Before the lens of the ocular collimator was placed a twin prism, the two prisms of which with their refracting edges of 1° to 2° were cemented together. By this twin prism each spectrum was decomposed into two spectra, and the dimensions of the twin prism were determined in such a manner that on the lid of the collimator one spectrum was situated above, the other below, while in the middle the second spectrum of the upper slit coincided with the second spectrum of the lower slit. In the lid of the ocular tube [illegible] small piece of determinate wave-length from the [illegible] spectrum [illegible] looking through [illegible] the field of vision would be seen divided by [illegible] refracting edges of the twin prism [illegible] halves, both of the same colouring. Before each of the two slits of the objective tube through which the light entered was placed a Nicol prism in such a position that perpendicularly polarised light entered one slit and horizontally polarised light the other. The middle [illegible] spectrum consisted, therefore, of [illegible] perpendicularly and horizontally polarised spectrum, and in the field of vision the two like coloured halves were also polarised perpendicularly to each other. If now the field of vision was viewed, not directly but through a Nicol prism, then, according to the position of this prism, would the one half at one time, the other half at another time, be withdrawn from sight; and if the two entering rays of light at their [illegible] possessed different degrees of intensity, by turning the [illegible] Nicol the two halves of the field of vision could be made equal, and from the rotation the relative degrees of intensity of the two bundles of rays could be determined.

VIENNA

**Imperial Academy of Sciences**, April [illegible] [illegible] Austrian [illegible] by [illegible] [illegible] hyposulphite of soda, by [illegible] mineral [illegible] by [illegible] vessels in the [illegible] by [illegible] the relation of Weber's theory [illegible] principles of the [illegible] Anlinge [illegible] contribution to the knowledge [illegible] Bohemia, by [illegible] Assyrian [illegible] by [illegible] Oppert [illegible] a new method for determination of the size of molecules, by [illegible] a new [illegible], by [illegible] Zehnder [illegible] the Egyptian [illegible] referred to in the Bible, by [illegible] Mahler.

April 23.—On spectrographical experiments [illegible] light sources, and on the [illegible] of the latter for photo-chemical measurement of light-intensities, by [illegible] knowledge of the [illegible] Laurentian [illegible] [illegible], by L. Haitinger and A. Lieben.

May [illegible] [illegible] by [illegible] F. [illegible] [illegible] [illegible] a knowledge of [illegible] [illegible] the knowledge of the structure of [illegible] Antimony, by [illegible] [illegible] by [illegible] glycerin, by A. Lieben [illegible] Tertiary deposits of [illegible] Lower Austria, by [illegible] and A. Karl.

May 14.—On the [illegible] by [illegible] the [illegible] of the dying matters of fungi, by A. Weiss. —The knowledge of the structure of the [illegible] [illegible] in the arms [illegible] of Botta [illegible] [illegible] [illegible] Langer.—On papaverine, by V. Batta and G. Goldschmidt.

May 20.—Prof. Stefan was elected Vice-President of the Mathematical Class; Prof. [illegible] Suess, Secretary; Prof. [illegible] Boltzmann (Graz), Prof. V. von Zepharovich (Prague), and Prof. C. Claus (Vienna) were elected Members; Prof. [illegible] Tschermak, Prof. [illegible] Vogl, and Franz Exner (Vienna), Correspondents; Prof. A. Bayer (Munich), Prof. T. D. Dana (New Haven), Foreign Correspondents.

May 21.—Anniversary Meeting.—The opening address was held by the Curator's substitute, A. von Schmerling. Then the reports were read by the General Secretary, Prof. Siegel, and by the Secretary of the Mathematical Class, Prof. Stefan. Obituary notes were given by the latter on Hochstetter, [illegible], [illegible] and [illegible]. A prize of 1000 florins was awarded to R. Maly [illegible], for his paper, "Researches on the Oxidation of Albumin by Potassium Permanganate."

STOCKHOLM

**Academy of Sciences**, May 13.—For the *Transactions* of the Academy were accepted: Researches on the diminutive electromotive [illegible] of the electrode during the passage of electricity through air of greater or lesser density, by Prof. Edlund [illegible] and [illegible] by Prof. W. [illegible].—Prof. Edlund exhibited and described a specimen of meteorograph of Theorell's construction, made by Herr [illegible] for the Emperor of Brazil.—Prof. [illegible] gave an account of the botanical researches undertaken by Messrs. [illegible] Neumann and [illegible] A. Tiselius in the Swedish provinces of Jemtland and Medelpad; and (2) contributions to the knowledge of the structure of the pericarp, by Miss [illegible].—Prof. [illegible] exhibited and described a geological map of Sweden, on the scale 1 : [illegible].—The Secretary, Prof. Lindhagen, presented for publication in the [illegible] of the following papers: The transversal oscillations in a thin crystalline lamina with three planes of symmetry and elliptical [illegible], by [illegible].—Alpha oxy-naphthalin [illegible], by Dr. J. E. Alén.—[illegible] naphthalin sulphonic acids, by Herr K. [illegible], by Dr. A. [illegible] on [illegible] researches on plants, by Dr. A. Malm.—Contribution to the flora of fungi in [illegible] parts of Norway, by Dr. E. Henning.—[illegible] whales, by Dr. A. Malm.

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## Diary of Societies

LONDON

*SATURDAY,* [illegible]

[illegible]

*MONDAY, JUNE* [illegible]

[illegible]

*FRIDAY, JULY* [illegible]

[illegible]

THURSDAY, JULY 9, 1885

## THE INTERNATIONAL SANITARY CONFERENCE IN ROME

[illegible] late Conference in Rome, which for [illegible] own reason stands adjourned for the present [illegible] de again in November, has arrived [illegible] the details of which are not published [illegible] full and authenticated report [illegible] [illegible] results achieved and the method [illegible] ference have already become known [illegible] ent to the daily papers, there is [illegible] those results with any [illegible] [illegible] the proceedings of the Conference [illegible] cannot be considered [illegible] its predecessors held in Constantinople [illegible]

[illegible] the present century Europe [illegible] cholera, and after [illegible] International Sanitary Conference was [illegible]

[illegible]

Marseilles, where it assumed, in July 1884, alarming proportions; thence it spread into Toulon, the south and north of France, into Italy and Spain, raging everywhere with great severity. If at any time land and maritime quarantine had a fair trial it was in 1884 in France, Italy, and Spain. [illegible] M. Fauvel, [illegible] France, that the [illegible] Marseilles and spread [illegible] other parts of France [illegible] quarantine after the [illegible]

[illegible]

that is more likely to further such a [illegible] and dangerous object. [illegible] Dr. Thorne, one of the English delegates [illegible] the Conference the [illegible] and danger of this recommendation. The French delegates leading the [illegible] turned a deaf ear to any reasonable suggestion [illegible] to have learned no lesson from the [illegible] that [illegible], fumigations, and all other measures of [illegible] without stopping the introduction and spread of cholera [illegible] in the past infected on their country.

If we ask ourselves, What [illegible] experiences [illegible] the [illegible] 1884 [illegible] gained in order to [illegible] the recommendations of the majority of the Conference [illegible] None, and those that have become known point in the opposite direction. The recommendation [illegible] quarantine off Suez [illegible] ships coming direct from India seems to imply that the [illegible] outbreak of cholera in Egypt owed its origin to importation from India. This view has during 1883-84 been stated and [illegible] by French writers with their usual self-confidence, but not a title of evidence has been [illegible] forward [illegible]. Moreover three [illegible] shown that that outbreak, which [illegible] Damietta [illegible] different [illegible] from Mecca. As Lord [illegible] delegate from England, has urged at the Conference [illegible] from India has ever been [illegible] into Egypt and Europe [illegible], considering the enormous number of vessels [illegible] from India [illegible] Egypt, the Mediterranean countries and Europe it is certainly a very remarkable fact that [illegible] happened in this manner, should not be of common occurrence.

The real danger from cholera for Egypt, Turkey, and Europe [illegible] Suez and the Suez Canal, but at Mecca and the countries about the [illegible] Sea, this being the route in which cholera has [illegible] viz., from Mecca, Mesopotamia, and Persia [illegible] Red Sea coast, Egypt, Syria, the Levant, Turkey, and Russia; and therefore these are the points of [illegible], which the European Powers [illegible] as England has [illegible] in the past, and [illegible] in this [illegible], every country [illegible] to protect itself as it thinks best. [illegible] our [illegible] as [illegible] should [illegible] has proved to be [illegible] they [illegible].

Cholera in Europe [illegible] from the East, it [illegible] such importation would [illegible] guard; but then the question [illegible] has been repeatedly asked [illegible] be practically achieved. To stop [illegible] and all communication with an infected [illegible], from the great practical [illegible] in carrying it out, [illegible] hardships, [illegible] that the remedy would entail greater [illegible] than the evil it was to cure, even granting, for the sake of argument, that it is capable of so doing.

Prof. von Pettenkofer in his [illegible] writings on the subject of quarantine has fully and clearly stated the case, and their perusal would have materially enlightened many of the members of the late Conference. They would also find in those writings what they might have found already in the protocols of the former conferences in Constantinople and Vienna, viz. that one of the *chief* and *first duties* of the State in order to prevent and check the spread of cholera is a *proper attention to general sanitation*. Make your [illegible] as strict as you please, stop and impede all traffic by sea and land as much as you like, fumigate your railway travellers and mails as carefully and rigorously as possible, you will not hereby succeed in stopping all communication with an infected country. On the other hand, give up all those costly and harassing [illegible], but keep a good look-out for infected ships coming to any of your ports, detain the infected persons in [illegible] fitted hospitals, disinfect the ship and [illegible], but allow the rest of the passengers and crew to depart, keeping their names and addresses, and notify their arrival to the sanitary authorities of the place they are bound to. Further [illegible] see that your dwellings, your water and air are in all [illegible] respects looked after, [illegible] and you will hereby [illegible] with all past and present experience, in order to [illegible] and disseminating cholera. It is [illegible] that general [illegible], and [illegible] are the [illegible] cholera is [illegible].

The principles [illegible] are practically those on which the [illegible] authorities in this country have been [illegible] the past and on which they are acting in the present. The [illegible] to this country from importation of cholera from Spain is greater than perhaps to any other, seeing the [illegible] existing between this country and the [illegible] coast of Spain; but there can be [illegible] should unfortunately [illegible] those gigantic [illegible] in France, Italy, and that [illegible] in Spain.

If one [illegible] conditions prevailing [illegible] time of the [illegible] procedures of the authorities in carrying [illegible] of the General who, in trying to keep out [illegible] is putting up on the frontier [illegible], but who has [illegible] the country with a real [illegible] clear the [illegible], and, having [illegible] and devastating the country.

## A NATURALIST'S WANDERINGS IN THE EASTERN ARCHIPELAGO

*A Naturalist's Wanderings in the Eastern Archipelago: a Narrative of Travel and Exploration from 1878 to 1883.* By Henry O. Forbes, F.R.G.S. With numerous Illustrations. (London: Sampson Low, Marston, Searle, and Rivington, 1885.)

MR. FORBES' Wanderings in the far East extended over about four and a half years, during which time he visited the Keeling Islands, Java, Sumatra,

in the developmental life-history of species. The overwhelming amount of evidence which has now been obtained of adaptations for cross-fertilisation, not in orchids only, but throughout the whole series of flowering plants, and the almost constant association of conspicuous form, colour, and odour with adaptations for insect fertilisation, force us to the conclusion that in almost all the cases adduced by Mr. Forbes we have species which were once adapted for insect-fertilisation. But in the terrific struggle for existence ever going on in tropical regions, insects are subject perhaps more than any other group of organisms to excessive fluctuations of numbers, sometimes culminating in the complete extermination of species, because they are equally liable to severe injury by physical and organic causes, by adverse seasons which destroy them in some of their earlier stages, or by the excessive attacks of insectivorous animals in both their larval and perfect states. It must therefore often happen that certain species of insects almost disappear in districts where they are usually abundant, and if any particular plant has had its flowers so highly specialised as to be adapted for fertilisation by one of these insects only, it must become extinct unless it occasionally produces varieties which are capable of self-fertilisation. The species of orchids in which a very small percentage of flowers produce seed capsules are evidently those in which the special insects adapted to fertilise them have become either temporarily or permanently scarce, and if that scarcity goes on increasing one of three things must happen—either the flower must become modified so as to be fertilised by some more abundant insect, or it must become capable of self-fertilisation, or it must become extinct. No doubt all these three cases occur, but it is of the second alone that we can obtain any knowledge, because we there find, as in our own bee-orchis, the special attractions of conspicuous form and colour which have yet ceased to be of service to the species. But no naturalist can doubt that these attractions were once serviceable; and we are thus led to conclude that all such instances are forms of functional degeneration which under changed conditions of the environment have afforded the only means of preserving the species.

Mr. Forbes's record of his thirteen months of travel in Sumatra are perhaps the most interesting portions of his book. He here met with some of the most marvellous productions of the vegetable kingdom—strange parasitical Rafflesiaceæ, an eccentric fig which ran underground and there produced its fruit, just showing their tops above the surface, and the giant arum (*Amorphophallus titanum*), some of which were seventeen feet high and with tubers six feet six inches in circumference. In the same forest huge earth-worms raised tubes of mud four and a half inches in circumference and eight inches high, and were so numerous as to render the whole surface of the ground as rough and hummocky as that of a newly-ploughed field. Here too, as well as in Java, he found a wonderful case of mimicry in a spider which deceived him even a second time; and he here obtained the rare *Ornithoptera brookeana*, perhaps the most chastely beautiful of all butterflies. Grand mountains, active volcanoes, glorious forest scenery, strange antique monoliths, and many interesting races of men, combine to render Sumatra one of the finest hunting-grounds yet left for the naturalist, while over the greater part of it there are facilities for travel or for residence rarely to be found in so little known a country.

In his later and more adventurous explorations of Timor Laut and Timor, Mr. Forbes was accompanied by his wife, a lady who seems to have endured all the annoyances, privations, and dangers of such a journey with truly heroic fortitude. Although these islands are far less known to naturalists than almost any other part of the Archipelago, they seem comparatively poor in a natural history point of view. A considerable proportion of the birds and butterflies of Timor Laut were new species, but the collections were scanty, and there is, no doubt, much still to be done there if a collector could freely explore the country and not be confined, as was Mr. Forbes, to a limited tract owing to tribal warfare. One of the interesting discoveries here was another example of mimicry among birds, in which a new species of oriole mimics a new honeysucker, just as do corresponding species in Ceram, Bouru, Gilolo, and Timor. A most interesting case of protective colouration was also observed in the white-headed fruit-pigeon of Timor (*Ptilopus cinctus*). These birds sat motionless during the heat of the day in numbers on well exposed branches, yet Mr. Forbes states that it was with the greatest difficulty that either he or his sharp-eyed native servant could detect them, even in trees where they knew they were sitting. The strongly contrasted white and dark colours of this species are such that any person looking at a specimen in a museum might take it as an example of a defenceless bird with very conspicuous plumage, and might ask triumphantly how our theory of protective colouration can be applied here. Yet it turns out that these strongly-marked colours so exactly harmonise with the colours of the branches of the trees on which it sits, exposed to the glare of the tropical sun, as to be completely protective; and we thus have another illustration of the impossibility of forming any correct judgment on this question unless we are able to observe each species in its native country and among the exact surroundings to which it has become adapted.

The hasty journey through the interior of Timor, among strange scenery and strange people, is full of interest. Most of the mountain tops, where alone a rich and interesting vegetation was to be found, were strictly tabooed, and it was often only by stratagem that specimens were collected; while the difficulties of travel in a country absolutely without roads and consisting almost wholly of an endless series of rugged mountains and deep valleys were exceptionally great.

The book is on the whole very well written, and will give the reader an excellent idea of some of the less known parts of the Malay Archipelago. The weakest part of it are the illustrations, which, though numerous, appear to be for the most part reproductions of rough sketches by some unsatisfactory process of photozincography. For this the author was probably not responsible, but his readers will regret that the strange and beautiful scenery he has so graphically described is not more effectively presented to the eye. The portraits of many of the natives are, however, very well done, while several good maps and a full index greatly add to the value of the book as a useful work of reference.

ALFRED R. WALLACE

## [illegible]VE ELEMENTARY TEXT-BOOKS OF HYGIENE

[illegible]*nual of Health Science.* Adapted for Use i[n] [illegible]ols and Colleges and suited to the Requirements [of St]udents preparing for the Examinations of the [illegible] Science and Art Department, &c. By Andrew [Wils]on, F.R.S.E., F.L.S. (London: Longmans, Green, [and C]o., 1885.)

[Law]s *of Health.* By W. H. Corfield, M.A., M.D. [illegible] (London: Longmans, Green, and Co., [illegible])

[illegible] *of Hygiene.* Expressly Adapted to the Require[ments] of the Syllabus of the Science and Art Depart[ment] South Kensington. By Albert Carey, F.R.G.S. [Lond]on: Thomas Murby.)

[illegible]. Its Principles as Applied to Public Health. [Adapt]ed to the Requirements of the Elementary and [Advan]ced Stages of the Science and Art Department, [and S]anitary Examinations at the Universities, &c. [By Ed]ward F. Willoughby, M.B. Lond., San. Sci. Cert. [illegible] & Camb. (London and Glasgow: W. Collins, [Sons] and Co.)

[illegible] a *Manual of Personal and Public Health.* By [Arthu]r Newsholme, M.D. Lond. (London: Geo. Gil[l and S]ons, 1884.)

[THE]SE works are partly if not principally intended [for] the use of students of the Science and Art [Departm]ent, South Kensington. It is very essential, [illegible], that not only should the matter be put in a [clear] and readable form, but that there should be no [e]rrors, as students of elementary works cannot be [expec]ted to recognise errors as such, from any knowledge [the]y possess on allied subjects. In fact they [illegible] by others besides, find a difficulty in conceiving [that wh]at is printed in a book need not necessarily be [true]. It is also necessary that the chapters should be [arra]nged, with the matter well assorted under head[s, and] that nothing of importance should be omitted.

[The "M]anual of Health Science," by Andrew Wilson, [F.R.S.E.], F.L.S., cannot be said to be in agreement with [thes]e principles. Many of the chapters are [illegible], and important points are omitted, especially in [the chap]ter on Removal of Waste. It is not [illegible] [fr]ee from errors, of which we may cite a few [illegible]: thus on p. 20 it is stated that "the [illegible] [gastr]ic juice" amount to over 900 parts per 1000, the [illegible]r being water [illegible] if such were really the case, the [illegible] being a liquid like water, would be a solid [inst]ead of being a liquid like water, [illegible] [illegible] dense character. Again, on p. [illegible] [illegible] [illegible]ing water "becomes a necessity [illegible] [illegible] [o]ur houses on any system, [illegible] [illegible] of a constant supply [illegible] [illegible] unnecessary. Again, at p. [illegible] [illegible] [in]dividual exhales about [illegible] cubic feet [illegible] [in]stead of per hour. [illegible] [d]raws foul air out, [illegible] [the]re are several other [illegible] [illegible]. An [illegible] [illegible] and hair washes [illegible] [illegible] manufacturer [illegible] [illegible] desirable as having [illegible] [adver]tisement. The illustrations [illegible] good.

"The Laws of Health," by Prof. Corfield, M.D., is a very valuable little work, and although not originally intended to form a class-book for the Science and Art Department, is admirably adapted for this purpose. It contains nearly all that it is necessary to know in a very small compass, and bears throughout the impress of the high scientific attainments and practical knowledge of the author. The chapters on Small-Pox and Vaccination is especially good, and its arguments very convincing.

"The Principles of Hygiene," by Albert Carey, F.R.G.S., is only of use for the first or elementary stage in Hygiene of the Department, although it is not so stated in the preface. The book is without illustrations, a great drawback to elementary students, and a good deal of space is devoted to matters of only secondary importance. It is therefore but moderately suited for the class of readers for whom it was written.

"The Principles of Hygiene," by E. F. Willoughby, M.B., San. Sci. Cert. Lond. & Camb., is intended for the use of students of all three stages of the Science and Art Department. It is also very well suited for the preparation of candidates for the University Examinations in Public Health. We can speak highly of this work, which contains sound and useful information on every subject necessary for the above courses, and is well up to the latest improvements and most generally received opinions in the science of which it treats. In our opinion it is perhaps better adapted for the advanced and honours students than for the elementary, as some parts intended for the latter are somewhat needlessly complex. The chapter on Vital Statistics is likely to be extremely useful to the University candidates, this somewhat difficult subject being here ably and intelligently treated.

"Hygiene: a Manual of Personal and Public Health," by A. Newsholme, M.D. Lond., is very well suited for students of the elementary and advanced stages. They will find here all that they require to know in an easily [illegible] form. We [illegible] with Dr. Newsholme [illegible] [illegible] [illegible] with that of several [illegible]. In many other respects the subject is ably treated by the author, and his work deserves a wide circulation amongst the science teachers of the [illegible].

## OUR BOOK SHELF

[illegible]

[illegible]

[illegible] proposition [illegible] These are merits [illegible]

[illegible] "references," saving the pupil the [illegible] of turning back [illegible] "def. 15," [illegible] to Prop. 48. So that if this one [illegible] itself into each proposition, it would have been [illegible] forty-eight times, and ever would it have greeted the student with a cheery "Here we are again."

But [illegible] all the first book could be printed on one side of [illegible] pages, which Mr. [illegible] book must be content to share with our "Revised Bible" [illegible] for the [illegible]

Below the "references" come a [illegible] collection of riders. We have looked at the [illegible] side of matters, but it would be doing Mr. [illegible] a very great injustice if we confined our attention to all the conveniences he has put together to ease the work of this class of students, of whom [illegible] we have had experience [illegible] getting up this particular subject.

Throughout there [illegible] of [illegible] explanation and illustration. The theorems are [illegible] in sections of subject-matter, [illegible] and converse theorems, as are the problems [illegible] for the [illegible] In fact nothing is [illegible]

To turn [illegible] page, the riders are exceedingly varied and well [illegible] and are [illegible] to draw out the [illegible] of a thoughtful pupil [illegible] the book.

If the first book of [illegible] "Elements" [illegible] edited in such [illegible] to those who [illegible] feel [illegible] with them, then the study of geometry [illegible] work.

*Botany* [illegible] *Specific* [illegible] *Pure* [illegible] By Vincent T. [illegible] (London: Blackie and Son, 1885.)

The preface to this [illegible] volume [illegible] books [illegible] text-books [illegible]

[illegible]

[illegible] and not very satisfactory treatment of some of the lower forms of vegetable life.

It is unfortunate that a book, parts of which might prove so useful, should be disfigured by serious blunders [illegible] should not the proof sheets, in cases like the present, be submitted to some competent authority, who would easily sift out the grosser errors. F. O. B.

*Journal of the Royal Agricultural Society of England.* Second Series. Vol. [illegible] Part I. (London: John Murray, 1885.)

This journal fully maintains the high character it has acquired under the able editorship of Mr. H. M. Jenkins. The part under notice is a bulky volume of nearly five hundred pages, and includes some eight or ten original papers by well-known agricultural writers, besides the [illegible] reports of the entomologist, chemist, and botanist to the Society. Prof. Wortley Axe reports on a recent outbreak of abortion in Lincolnshire [illegible] Prof. [illegible] in sheep. Mr. S. B. S. [illegible] a significant paper on the [illegible] of the agricultural population of England and Wales between the returns of [illegible] Dr. J. H. Gilbert, F.R.S., [illegible] of the late Dr. Augustus Voelcker, the paper being accompanied by a graphic [illegible] on sugar as a food [illegible] at its present low [illegible] economical [illegible] with other [illegible] Mr. H. [illegible]

[illegible] the prairie [illegible] after discussing the [illegible] vast region, the character of [illegible] and value of its [illegible] climate, he [illegible] of the agri[illegible] West Territories, and [illegible] to the [illegible] The moderate and [illegible] will enhance [illegible] Atlantic, and lead [illegible] of the second [illegible] with the agriculture [illegible] In the course [illegible] to have discovered [illegible] and agri[illegible] also contains a report [illegible] at Woburn, by Dr. [illegible] the author gives [illegible] matters of [illegible] of his late [illegible] to the [illegible]

## 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. No notice is taken of anonymous communications.*

*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### An Earthquake Invention

With reference to the [illegible] on this subject in this week's NATURE [illegible] will you permit me to state [illegible] in the British Association Report for 1881 Prof. [illegible]

[illegible]

Swallows

[illegible]

### Occurrence of Lumpenus lampretiformis and Gadiculus argenteus off Aberdeen

[illegible]

The Limitation of Vegetation

[illegible]

[illegible]

The men allege that the "[illegible] water" has an injurious effect upon their tackle, and that it causes them to take of some kinds of fish. It continues for about a month and then disappears. This year I have had and will have some of the organisms under microscopic observation, and I am very anxious to know if they have already been the subject of scientific inquiry, or not; and also information as to the geographical extent of their diffusion.

[illegible] Sheerness-on-Sea W. H. SHRUBSOLE

### Composite Portraits

IT is most unfortunate, but an obvious fact, that in the sheet of composite portraits of American [illegible] in NATURE of June 25, Figs. 2 and 3 are impressions from one and the same negative. Not only are they alike, but they present the same peculiarities, even the same defects. If it were not so, they would serve to throw [illegible] the whole [illegible] founded upon such averages; for if [illegible] naturalists and 31 [illegible] present two composites which are indistinguishable, [illegible] what purpose is the average. C. M. INGLEBY

Athenæum Club

## IRIDESCENT CRYSTALS OF CHLORATE OF POTASH

THE appearance of Mr. Madan's paper in NATURE (vol. xxxii. p. 102) induces me to offer some additional remarks on this subject.

In the discussion that followed the reading of my paper Mr. Crookes referred to the closely analogous spectra exhibited by opals, as described in his paper (Proc. Roy. Soc., vol. xvii.). This paper, though it came before me at the time when it was read, was not in my mind when I wrote my own. I called shortly afterwards at Mr. Crookes' house, and saw the spectra of his opals. Supposing that there were sufficient grounds for the commonly received idea that the colours of the opal are due to fine tubes in the mineral, we did not at the time conceive that the phenomena could be the same; were it not for this, I should certainly have added to my paper a reference to that of Mr. Crookes.

Mr. Crookes was so good as to lend me his opals for more leisurely study. The further examination has so impressed me with the similarity of character of the spectra, that I am strongly disposed to think that the colours of the opal and those of the chlorate crystals may be due to the same cause. This does not, however, lead me to attribute tubes or striæ to the chlorate crystals, the structure of which can comparatively easily be made out, but to doubt very greatly the theory which attributes the colours of opal to fine tubes.

Mr. Madan does not profess to have actually seen in the chlorate crystals such tubes as he supposes to exist, nor could I see anything of the kind on examining some of the crystals I have got after the appearance of his paper. On the other hand, I notice that Brewster did not state that he had actually seen the supposed tubes, but merely inferred their existence from a comparison of the appearance under the microscope of the precious opal with that of hydrophane. And Mr. Crookes tells me that an opal is not spoiled or affected by being immersed in water or even oil. The fact is that it is extremely difficult to make out what the actual structure is with which we have to deal in the case of the opal, whereas in the case of the chlorate crystals it is almost visible. Moreover, in the case of the chlorate crystals there is a wonderful uniformity in the phenomena presented by the same crystal, extending, it may be, over nearly the whole of even a large crystal, whereas in the opal the colour extends over comparatively small patches; and even a single patch is seen under the microscope to present differences of structure in different parts. Hence if the colours in opal and those in the chlorate crystals are really due to a similar cause, it seems much more likely that a study of the phenomena of the chlorate crystals will throw light on those of the opal, than that the phenomena of the opal should furnish the key to the explanation of the colours of the chlorate crystals.

In truth, I do not see how the presence of tubes, if such there be in the opal, would account for the phenomena, and especially for the very peculiar spectrum exhibited. The supposition of the existence of rows of tubes leads one to look in the direction of diffraction. But I do not see how monochromatic light, or, at least, light almost monochromatic, can be obtained by diffraction. And even independently of this consideration there is one feature of the production of colour in the chlorate crystals which shows, at once and decisively, that at least in their case the colour cannot be due to diffraction. If an iridescent crystal be chosen with an even surface, and the flame of a candle in a dark room be viewed by reflection in it, it is found that the colour is seen in the direction of the regularly-reflected light. In fact, the coloured light forms a well-defined image of the flame of the candle, coinciding with, or overlapping, the colourless image due to reflection from the first surface. This differs altogether from what we get in the case of a grating, or in that of mother-of-pearl or Labrador spar. It agrees so far with the colours of thin plates, or the colours shown by reflection by certain quasi-metallic substances, such as several of the aniline dyes, though the production of colour in these three cases is due to three totally different causes.

It has been conclusively proved that the seat of the colour in the chlorate of potash crystals is in a very thin twin stratum; and I entertain myself little or no doubt that the colour depends in some way on the different orientation of the planes of polarisation in the two components of a twin, and on the difference of retardation of the two polarised pencils which traverse the thin stratum. But anything beyond this is at present only a matter of speculation. I see only two directions in one or other of which to look for a possible explanation; but as these could only be propounded at considerable length, and the matter has not at present advanced further, I refrained from saying anything about it in my former paper, nor will I further mention it here.

In conclusion, I would mention an interesting paper on "The Spectrum of the Noble Opal," by Prof. H. Behrens, a copy of which I have just received by the kindness of the author. In this paper, which is printed in the *News Jahrbuch für Mineralogie*, &c., 1873, the author, who was evidently unacquainted with Mr. Crookes's paper when he wrote his own, has described and figured the peculiar spectra of several opals. G. G. STOKES

## EXPERIMENTAL FARMING

ENGLISH farmers are not readers. They do not know, apparently, that there is much to unlearn in the practice of their art, old as it may be. But although they will not allow themselves to be enlightened by books or newspapers, they are not incapable of imitation, and for this reason experimental farming, carried out in any particular district on a practical manner, has always proved useful. Up to the present time the history of experimental farms in England is, so far as their number is concerned, a meagre one. In the whole of Europe there are 100 experimental farm stations, of which number the United Kingdom can boast of about half a dozen, including Rothamsted; Woburn, which, by the Duke of Bedford's munificence, has become a field of experiments for the Royal Agricultural Society; the stations of the Highland and Agricultural Society, of the National Board of Education in Ireland, and of the Agricultural Association of Sussex. It is a characteristic feature of our English system that the State lends no assistance to either of these establishments, while that of Sir John B. Lawes, at Rothamsted, has been conducted for many years on a princely scale by the owner at his sole cost.

The Rothamsted station, founded in 1843, has become ost prominent teaching establishment in the world. is not a single point of interest connected with the ng and manuring of the land, the forming and ent of pastures, and the feeding of animals, which t been made the subject of exhaustive experiment thamsted, while the silo experiments which have ately undertaken for the purpose of testing the of ensilage, will probably do more for the interests those land-proprietors and large farmers who are ng them than all else which has been said or done rd to this much-praised cattle food. It would be e indeed if agriculturists refused to listen to Sir awes, but although certain facts of prime import- in the long catalogue of useful lessons from msted have been widely distributed, the voluminous s of the great experimenter, trusted as he is, are it by one per cent. of those on whose behalf they ndertaken. Some of the more important teachings hamsted have become so familiar that they have into agricultural axioms, such as "phosphates for nitrogen for corn." We have ourselves known s who have travelled a hundred miles or long for such men—for the purpose of seeing for them- at Rothamsted how corn might be grown continu- y means of small dressings of nitrogenous manures. us they have solved a problem of vital importance nselves and their families. But comparatively few will trust themselves so far from home ...

stuffs, town sewage, the question whether plants assimilate free nitrogen, ensilage, rainfall, and the waste of nitrogen in land-drainage water. It has been stated that some of the elaborate investigations which have been conducted at Rothamsted are too "scientific" for humbler establishments. If by science we mean a complete knowledge of facts the phrase is hardly accurate, but no doubt some of the Rothamsted experiments were accompanied by the analyses of animals, plants, and soils, and could not therefore be repeated at ordinary stations. On the other hand, the most useful experiments for the instruction of farmers are those which relate to the effects of the different foods employed for plants and animals, and in these ... farmers can themselves form estimates of the results which will prove sufficiently accurate for practical purposes, and ... lead to the saving of millions which are now annually wasted through the ignorant use of manures and improper feeding of animals. H. E.

## ELECTRICITY AT THE INVENTIONS EXHIBITION

*The Secondary Generators of Messrs. Gaulard and Gibbs*

HITHERTO there have been two means employed for electric illumination and the electric transmission of energy, viz. supplying the electricity required for the lamps or other receivers (1) direct from the dynamo machines, and (2) from secondary batteries charged by means of dynamos. A third method has been recently introduced, by means of secondary generators, of which a small installation has been made at the Inventions Exhibition, to which we propose to refer in this article.

The object of this invention is to supply a current which may be varied at will both as regards electromotive force and quantity, and thus be made applicable to work at the same time arc lamps, incandescent lamps, and motors. The means by which this result has been ... by interposing between the dynamo machine and the lamps or other receivers of electricity a supplementary apparatus, by the aid of which an induced current is produced proper to the particular receiver ...

The ... Company for the Distribution of Electricity by Secondary Generators, which works the patents of Messrs. Gaulard and Gibbs, ... secondary ... They were ...

for the induced current are similarly electrically connected. In constructing the secondary coils, they are fixed together between two insulating surfaces by bolts and nuts, the projections by which the several conducting disks are connected projecting helically or spirally around the coil (the projections of the primary alternating with those of the secondary coil), and form convenient means for connecting up any number of convolutions as required.

The end disks of one of the helices thus formed are connected to the leads of the primary circuit by binding-screws, and the end disks of the other helix are similarly connected to the leads for the induced or secondary current. In the centre of the disks is a hollow cylinder of paraffined cardboard or other suitable insulating material, around which the helices are arranged, and in this cylinder is a core of soft iron, or of soft iron wires, which is capable of being automatically raised and lowered in the cylinder, so as to regulate as required the current passing through the coil.

The main wire from the dynamo is connected up in series to the primary helices of a group of secondary generators, and, in passing through the primary helices, induces a current in the secondaries, the tension of which, according to the experimental investigations of the inventors, increases first with the intensity or quantity of the primary current, and, secondly, with the rapidity of the interruptions or alternations, or the variations of its potential. Each secondary generator forms a complete installation, and can be put in or out of circuit at pleasure. The secondaries may be connected up in series, in multiple arc, or in multiple series, as desired, the connections being readily altered by means of a switch-board; tension or quantity is thus obtained according to the nature of the current required. The lamps or other receivers fed from the secondary generator can be connected at will to their respective circuits, and are also independent of one another.

These generators are made to work in connection with alternate-current machines, because the latter can be constructed up to almost any power, as no two parts of the machine having great difference of potential need be in close proximity, and the alternation of current may be made as quickly as desired. The generating dynamo is so constructed and operated that the quantity of current is preserved constant, and the tension is varied to carry this current through the primary conductor against the varying counter electromotive force due to variations in the work done in the secondary circuits of a number of secondary generators. If $W$ represents work, $C$ current, $E$ electromotive force, and $R$ resistance, and if either of these factors be changed, the others must be altered in the same ratio, according to the formula—

$$W = CE = C^2R = \frac{E^2}{R},$$

if uniform effects in the secondary circuits are to be desired.

One of the chief characteristics of this system is that if the primary current be kept constant the loss due to resistance remains fixed, no matter what energy is transmitted—so that if an increase of energy is desired, the only factor that has to be increased is the electromotive force, which bears no ratio to the loss in the conductor. This circumstance is of importance in any house-to-house lighting scheme, where a conductor may be laid down to supply a certain area, and if the lights are not taken up at once, the necessary current can be supplied later within the limits of the dynamo, by increasing the electromotive force, without increasing the size of the conductor, the strength of the current, or the loss in the line.

As regards the very high potential required upon the secondary generator system, the danger is limited to the supply station, as between the two poles of the main dynamo there is an unbroken metallic circuit, which maintains the continuity of the flow of current; and as regards each secondary circuit the work done is represented by a secondary generator, and the only danger would be in grasping both primary terminals at once, which may be made impossible of performance. It will be necessary as regards the dynamo that it shall be insulated from the earth, and also that such parts of the circuit as carry high tension electricity shall be so protected that it shall be impossible to make contact between them and the earth.

In comparing this system, in which there is a loss in the transformation of the energy by the secondary generator, with the direct system, this loss will have to be balanced against that caused by resistance due to distance, whilst as regards the regulation of the supply of energy, this is effected by means of a regulator working the exciting machine of the dynamo at the station; by its means, when a secondary generator is cut out of circuit, a proportionate amount of power is saved. The secondary generators also regulate the energy absorbed, so that a perfect control of power is obtained, which is especially important for domestic supplies of electricity, as, when a suitable current measurer has been designed, consumers will be able to pay simply according to the amount consumed.

At present the extreme northern end only of the East Arcade at the Exhibition is being lighted on this system; it is proposed, however, to extend it to the full length of the East Arcade and to the concert-room.

## *THE AFGHAN DELIMITATION COMMISSION*

WE are indebted to the courtesy of the Kew authorities for the opportunity of publishing the accompanying letter from Surgeon-Major Aitchison, C.I.E., F.R.S., which gives the most recent account of his work as naturalist to the Expedition:—

*Camp Tir-Phul, Northern Afghanistan,*
*6 miles from Khusan*

DEAR SIR JOSEPH HOOKER,—

I am now able to write to you with some pleasure, as I have been able to put together this year some 300 species in all. The last 100 I obtained on a ten days' trip that I made from this camp. I left this on April 25 under very bad auspices, as it had blown all night and was blowing a terrible gale with every chance of a heavy fall of rain from the north But I started and got as far as Khusan, in the vicinity of which, beside the ruins of an old "serai," I halted. I picked up a few odds and ends, the chief attraction was the *Rosa margerita* (if a new sp.) *miki*. It covers the whole country in localised patches, and being very dwarf in habit, not above 2 feet, the flowers are seen to perfection; they open out expanding almost flat, when the brilliant eyes, formed by the claret colour of the bases of the petals, gives it quite a character. Amongst my rose hips sent to you last year this was one of the species. I hope to be able to supply you with a lot more, it would make a lovely flower border.

I marched next to a place on the right bank of the Hari-rúd River opposite Tomán-ághá, fifteen miles. Our route lay over a plain that had once been the bed of the river where the river had made a great bend; the river, after silting up this bend, had left it. The most characteristic plant here was a Rhubarb, usually with 3-root leaves of immense proportion for the size of the flowering stem; these leaves are so pressed flat to the ground that it reminds one more of the *Victoria regia* leaves (without the margin), and this is the habit of the plant; the plant was fruiting, having large winged fruit of a most brilliant scarlet; it will make a grand thing in gardens. The beautiful colour of the fruit is much helped out by the splendid green of the leaf background. There are, one may almost say, no leaves on the flowering stem—one or two most minute. I measured one of the largest on the ground: it was 4 feet from the base to apex and 5 feet across; the other two with this one were a little smaller; the three together gave it a very curious look. I hope soon to get the seeds home. I have collected a good deal of the root; it is called "Fool's Rhubarb" owing to its purgative qualities, and curiously enough the fruit is employed in preference to the root as a purgative, given as a decoction. With the exception of an occasional woody shrub that may rise to five feet, the place was covered with a species of Artemisia (probably several) about 2 feet high, and occasional Umbelliferæ. There were no trees of any sort: these are only to be found in the river bed —viz. *Populus euphratica*, and two species of Tamarisk and a Lycium. At Tomán-ághá, in the bed of the river, was a woody salsolaceous shrub which I do not know. I got good specimens of the wood and flowering branches.

I left Tomán-ághá on the 28th, passing the remains of some old ruins two miles from my encampment, and turned east by north towards "Galicha" (a carpet). As we marched along, fancy crossing the markings of two pairs of carriage wheels! These had been made some months ago by the carriage of a Persian Prince who had come to our camp at Gulran to be doctored The route lay now across towards the base of the Paropamissus range over a most extensive plain on which the attraction was a miniature forest of a species of Umbelliferæ, excessively like, but not the, Assafœtida. This was in full bloom, the stem and flowers being at first all of a light orange yellow; as the fruit ripens, the whole colour changes to a russet brown. Each flowering stem is from 3 to 5 feet high, and there are usually 50 plants to 100 yards square, the interspaces being altogether filled up by a grass of a foot in height. On the 29th, left Galicha for the Kambao Pass to enable me to cross through the range. Our march lay over a plain the continuation of that of yesterday, and which from its extent is lost to the sight. This is celebrated as the plain of the wild donkey, and here I counted sixteen herds of at least 10,000 in each. The nearest was a mile off, and their presence was recognised by a cloud of dust rising in a swirl on their galloping—like the smoke from the chimney of a steamer. It was a most extraordinary sight, watching these clumps moving from place to place. They are occasionally shot and eaten. I forgot to tell you that, except my own party, there was probably not a human being within thirty miles of us. The country has *no* inhabitants, and until the nomads turn up with their flocks from the lower regions it is a desolation. The last part of our march was for six miles within the ridges of the base of the hills, and here in the stream beds Tamarisk was the only (woody) shrub. I halted some five miles to the west of the pass, hoping to make a great haul on the 30th. From the moment of entering these valleys they seem a mass of colour—one from buttercups (one species only), another from a poppy; the bed of the stream purple with a tall onion, and the interstices green with one grass. I had previously got most of the things so promising here, but saw signs of getting into a very fine new lot. On the morning of the 30th a regular hurricane of wind blew from the north, so that I thought the best plan would be to move my camp across the pass, and get a better and more sheltered locality. I just managed to get to the north-east side, when it *did* come down—such a torrent! but as all preparations had been made we were comfortable; had I remained on we must have been swept out of our old camp.

May 1 proved a most superb morning, so I was up and out at 6 a.m., went straight back to my old encampment on the west side, and from there collected back. I got some thirty-five species—a second Arum; a Prunus; an Elæagnus, of which I sent you the fruit last year; one Pistachia bush, a large number of Astragali, which I feel sure will stump Baker; a curious Rubiaceous shrub, a fine Orobanche, only five grasses, and a most lovely everlasting pea, like the ordinary English cultivated one, only dwarf. I believe everything here is dwarfed by exposure to the winds. You cannot understand the difficulty I have with it in collecting. To save my plants at all, I have to put them *at once* into paper. It takes three of us to do this, and not allow paper or plants to blow away. I must say it does not improve one's temper.

I got one or two species of a very nice Gentian like *Gentiana Kurroo* of Royle, the altitude of Hari-rúd River, 2000 feet; Kambao Pass, west side, 2900 feet; pass itself, 3550 feet; Kambao on north-east, 3250 feet. Not a fern of any sort, not even Ophioglossum, which I looked upon as a certain find. I spent my second day—viz. May 2—at the camp on the north-east side of pass; here there is a fine hawthorn, from which I collected flowers in bud on the 1st. Along the whole of this range, well within it, where the water is sweet and the air cool, the hawthorn, a common plum, and *Amygdalus eburnea*, are more or less plentiful. I picked up an Oxygraphis, and a very pretty geranium with a most curious potato-like root, only the tubers are heaped up on each other when there is more than one to a plant. You know they made me naturalist, so, in addition to collecting plants, I have to shoot poor little birds, and I hate it. I got two bee-eaters, the one more lovely than the other, and a nightingale.

On the 3rd I marched to a place 8 miles nearer our first Gulran encampment. I had picked up most of the cream, and there was not much, except additions in the way of fruiting species, to be made. This I did, and got a venomous snake which may be a cobra—all but walked on to him—5 feet long and 6 inches at his thickest, fangs three-quarters of an inch; a most unpleasant fellow to meet. I shot him, and after fancying I had killed him, cut off his head and neck to keep (I could not keep his whole body), when lo! his body, minus his head, walked off searching for escape, the head trying to fang its own neck.

On the 4th I moved still east-by-north some 12 miles to our first encampment at Gulran. I got some nice things *en route*, and had just ticketed and arranged them preparatory to great work for the morrow, when in came a letter from Sir Peter Lumsden telling me to return at once. Alas for my great expectations! I packed up, and we moved camp at 2 a.m. on the 5th, marched up the valley, passing our second Gulran encampment, and on south to the east-by-north side of the Chashma-sabz Pass. I had no time to halt and collect. I passed a Gladiolus and an immense number of things. On the pass I collected the "Siah-chot," which is to me, in all probability, *Cotoneaster nummularia*. I had collected its fruit and sent it to you from these very bushes. I got it in this pass last year. It is from this shrub that "Shir-Khist," the manna of these parts, is collected. I have sent you a bottle of it packed amongst some other things. They have two other kinds—one from a Tamarisk and the other from Alhagi. I myself collected it from a Salsola. I got across the pass by 2 p.m.; halted until 8 p.m. and got into Tir-Phul at 8 a.m., the camels at 10 a.m. of the 6th; did 60 miles in 34 hours—good going for camels, and men more or less on foot.

I am glad I am in, because my plants had to be looked to. I got, as I said before, 100 species in this tour, not less than 1200 specimens. It is much harder work than Kurram; the fact is, I am not younger, and my back wants a good deal of oiling.

Yours very truly,

J. E. T. AITCHISON

## AN OLD DRAWING OF A MAMMOTH[1]

AS an addendum to the historical review of the mammoth discoveries in Siberia and the traditions to which they have given rise, which I have rendered in the "Voyage of the *Vega*," I have the pleasure of presenting a curious drawing of the animal, discovered among the Benzelian MSS. in the Linköping library. My attention was directed to the original by the president, Herr Hans Forssell, who, in his memoir of Erik Benzelius the younger, has given an account of the proceedings which it occasioned in the Upsala Scientific Society.[2]

The drawing bears the following inscription:—

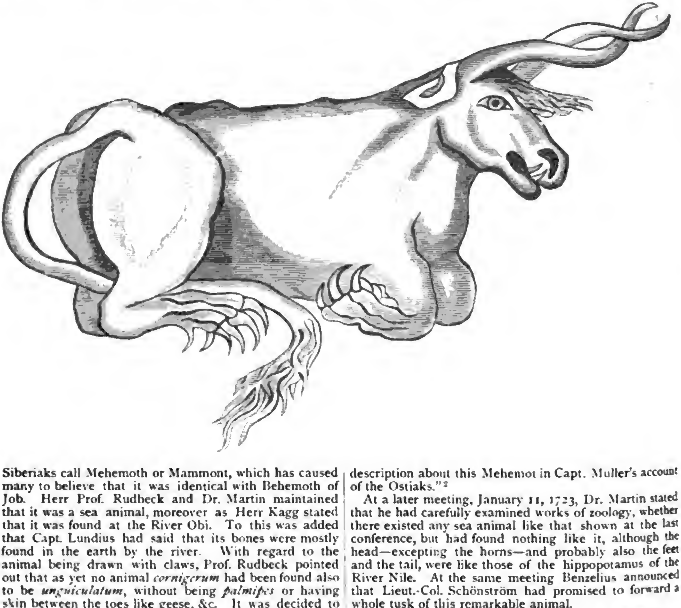
"The length of this animal, called Behemot, is 50 Russian ells; the height is not known, but a rib being 5 arsin long, it may be estimated. The greatest diameter of the horn is half of an arsin, the length slightly above four; the tusks like a square brick; the foreleg from the shoulder to the knee 1¾ arsin long, and at the narrowest part a quarter in diameter. The hole in which the marrow lies is so big that a fist may be inserted, otherwise the legs bear no proportion to the body, being rather short. The heathens living by the River Obi state that they have seen them floating in this river as big as a 'struus,' *i.e.* a vessel which the Russians use. This animal lives in the earth, and dies as soon as it comes into the air."

On the reverse of the drawing we read:—

"This drawing and description is given by Baron Kagg, who has just returned from captivity in Russia and Siberia,[1] 1722, in Decembri."

This drawing was exhibited by Benzelius at the meeting of the Upsala Scientific Society, December 14, 1722. The statement referring thereto in the *Journal* of the Society is as follows:—

"Herr Benzelius exhibited a good drawing of an animal, transmitted by Baron Kagg, who has just returned from captivity in Russia and Siberia, which the



Siberiaks call Mehemoth or Mammont, which has caused many to believe that it was identical with Behemoth of Job. Herr Prof. Rudbeck and Dr. Martin maintained that it was a sea animal, moreover as Herr Kagg stated that it was found at the River Obi. To this was added that Capt. Lundius had said that its bones were mostly found in the earth by the river. With regard to the animal being drawn with claws, Prof. Rudbeck pointed out that as yet no animal *cornigerum* had been found also to be *unguiculatum*, without being *palmipes* or having skin between the toes like geese, &c. It was decided to write to Herr Kagg, requesting some information about the figure, and asking how he had obtained it, so that it might be ascertained whether it was reliable. There is a description about this Mehemot in Capt. Muller's account of the Ostiaks."[2]

At a later meeting, January 11, 1723, Dr. Martin stated that he had carefully examined works of zoology, whether there existed any sea animal like that shown at the last conference, but had found nothing like it, although the head—excepting the horns—and probably also the feet and the tail, were like those of the hippopotamus of the River Nile. At the same meeting Benzelius announced that Lieut.-Col. Schönström had promised to forward a whole tusk of this remarkable animal.

On later occasions too the animal was discussed by the Society. Thus on January 18, 1723, a letter was read from the learned linguist, Sparfvenfelt, wherein he explains the derivation of the words Behemoth and

[1] Published in *Ymer* (Journal of the Swedish Anthropological and Geographical Society), 1884, Parts 7 and 8. (Translation communicated by the Author.)

[2] "Svenska Akademiens handlingar" (*Proceedings* of the Swedish Academy), Part 58. Stockholm, 1883, p. 315.

[1] Major L. Kagg was taken prisoner at the River Dnieper in 1709, and brought to Tobolsk, whence he returned in 1722.

[2] J. B. Müller's "Leben und Gewonheiten der Ostiaken unter dem Polo Arctico wohnende," &c. Berlin, 1720.

Mammont; on February 15 a letter was read from Benzelius, stating that Kagg had received the drawing from a Capt. Tabbert, and that he could give no information as to its correctness. Again, on October 3, Benzelius exhibited a large bone, almost petrified, which was the jaw of a Mammont, or as it was called Behemoth, received from Tobolsk in Siberia, through Capt. Clodt von Jürgensburg, and, on November 22, Benzelius exhibited "part of the tusk of a Behemoth, which was exactly like ivory." Finally, Benzelius communicated with the Russian Chief of Mines, Tatischew, who, in a letter dated May 12, 1725, had given long and important information of the history of the mammoth. This letter is printed in "Acta Literaria Sueciæ" (vol. ii. p. 36, 1725).

A. E. NORDENSKIÖLD

## *NIAGARA FALLS: THE RATE AT WHICH THEY RECEDE SOUTHWARDS*

THE diagrams are from the map issued by the New York Commission for the establishing a State reservation at the Falls, based on surveys made in August and September, 1883, by Thomas Evershed, under direction of Silas Seymour, State Engineer and Surveyor. The scale of the diagrams is one half that of

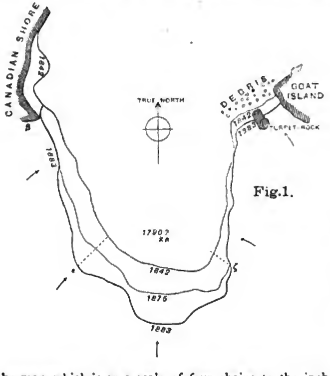


Fig.1.

the map, which is on a scale of four chains to the inch. To have given all on one diagram with the intervening Goat Island would take up nearly an entire page of NATURE, and if the scale were smaller it would fail to show clearly the distinctive features of the changes in progress. Fig. 1 shows the Canadian or Horse-Shoe Fall, Fig. 2 the Eastern or so-called "American" Fall—a misnomer too deeply rooted in usage to be now supplanted by some more fitting name.

The rate at which the Falls are receding has been a matter of interest to geologists for over fifty years, but the results so far reached have been conflicting and inconclusive. The manner in which the Falls work backward, undermining their brink, is so well known from Lyell's clear description, that I shall not repeat it.

In 1830, Bakewell, on the basis of such information as he could gather from old inhabitants and from his own observations, concluded that during the previous forty years the Falls had receded at the rate of three feet per annum.

Lyell, from such materials as he could obtain during his own visit in 1841 and 1842, estimated the annual retrograde motion at only a foot. It is sufficient to recite such discordant results arrived at by two careful investigators to show how imperfect were the materials at their disposal, nor will any one who has been on the spot wonder at their differing so greatly. It would be possible to roughly compute the southward movement of the innermost recess of the Canadian Fall by referring its position from time to time to some fixed points on the adjoining shore, but any conclusive determination of the movement of the entire Fall could not be obtained in this way. The map referred to gives the outline of the Falls as determined by three surveys: the New York Geological Survey of 1842, the U.S. Lake Survey of 1875, and Evershed's Survey of 1883. The contours of the brink as established by these enable us to measure the total movement.

I divide the contour from β to Goat Island into thirty-three sections, disregarding for obvious reasons the overflow north of β, on the Canadian shore. From β to ε are eleven sections, from ε to ζ are twelve sections, from ζ to Goat Island are ten sections. It is obvious that much the greater work has been done between β and ζ, and that the innermost recess has kept in the same relative position.

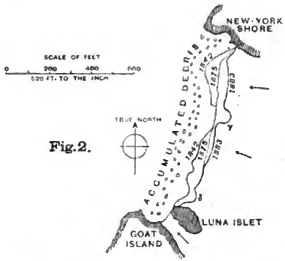


Fig.2.

The means of the measurements on the sections, along perpendiculars from the contour at the date of each survey, measured on a tracing of the published map, give the following results for the Canadian Fall:—

| | 33 years ending in 1875 ft. | 8 years ending in 1883 ft. | 41 years ending in 1883 ft. |
|---|---|---|---|
| Mean aggregate recession along contour of 2000 feet, from β to Goat Island = ... | 80 | — | 114 |
| Mean aggregate recession along contour of 1200 feet, β to ζ = ... | — | 60 | — |
| Mean annual rate of regression along the whole contour where a visible change was effected = ... | 2½ | 7½ | 2¾ |
| Total maximum regression at the innermost recess = ... | 118 | 135 | 253 |
| Annual rate of maximum regression = | 3⅝ | 16⅞ | 6⅛ |

The "American" Fall, measured in ten sections, gave a total mean recession of 37½ feet in the 41 years ending in 1883, which is at the rate of about 10 inches per annum.

I do not know that I have seen any estimate attempted of the relative volumes of water passing over the two falls. From such imperfect data as I have, referring to depth and swiftness, I should think that the rate of erosion for each fall gave some approximation to the volume of water discharged over each; that is to say, 2½ feet per annum for the Canadian Fall, ⅔ foot per annum for the "American" Fall, would signify that the former pours over its brink three times as much water as the latter.

At the rates of recession above shown it is evident that at no very remote age the two falls were united in one when abreast of the point in Fig. [illegible] marked "New York Shore," and the entire width was about the same as that of the present Canadian Fall alone. Moreover, the mean width of the fall, from the time it commenced its work at the "heights" seven miles below its present position, according to Lyell's statement as to the gorge of Niagara River, was not greater than the present Canadian Fall. Adding together the present work done by both falls, we should have about 3⅓ feet per annum as the backward work performed when the entire volume poured over a single fall of the width of the present Canadian Fall.

At this rate 10,000 years would seem sufficient time for the cutting out of the present gorge terminating at the "heights" towards Lake Ontario, instead of Lyell's estimate of 35,000 [illegible]. All attempts to [illegible] the rate of movement proceed on the assumption that the hardness of the limestone and shale, the volume of water, and the height of the fall, were, for the whole distance, much the same that they now are. I merely use these same assumptions. It in no way [illegible] Lyell's judgment that he should have [illegible] in attempting to estimate the rate of recession, while yet the contour of the fall at different periods had not been fixed by triangulation. He was [illegible] the first to [illegible] a [illegible] when he could lay hold of something more solid [illegible], and it was by [illegible] judgment on [illegible] natural phenomena that [illegible] interest in such matters was chiefly awakened.

The statement [illegible] Hooker, [illegible] guide [illegible] 1841, [illegible] of 40 feet [illegible] made [illegible] "American" Fall since 1815 seems to contain the basis on which he estimated the rate of recession for both falls, as this amounts to a little over one foot per annum. A reference to the [illegible] to have been approximately correct for the [illegible] at the "American" Fall, but [illegible] when applied to the much more important Canadian Fall.

A consideration of his sections of the Niagara River leads me to suppose that the falls in the earlier part of their history worked [illegible] more rapidly than [illegible] the brink, but I will not venture further upon your space at present. [illegible] WOODWARD

Providence, R.I., U.S.A., June [illegible]

## NOTES

[illegible]

THE [illegible] Medal—founded [illegible] for the [illegible] to Mr. W. [illegible] of [illegible].

THE long excursion of the Geologists' Association this year will be to Belgium (the Meuse and the Ardennes, Brussels, Dinant, Namur, Liege, Maestricht), under the direction of M. Ed. Dupont (Director of the Museum, Brussels, and of the Belgian Geological Survey), Prof. A. Renard, Dr. E. Purves, and Prof. J. Cornelis. The party will meet in Brussels on Monday, August 10, and will proceed the same evening to Chaleroi. Further particulars as to fares, routes, &c., will be given in a special circular, which will also contain full particulars of the geology, with illustrations and references. The total expense during the five days of the excursion (Tuesday to Saturday) will vary from 15s. to 20s. per day for each person. This will include conveyance, also a special steamer on the Meuse, stopping at the various points of interest. By this arrangement much can be seen in a short time. The papers on the geology of Belgium read at the July meeting will be printed, with map and illustrations, for the use of the members during the excursion. Those proposing to join the excursion are requested to give early notice to the Secretary, who will supply further information if required.

A MONUMENT was unveiled last week at the École Normale, Paris, to Dr. Thuillier, the member of the French scientific mission to Egypt who died of cholera at Alexandria in 1883.

THE anniversary meeting of the Sanitary Institute is held today at the Royal Institution at 3 p.m. The chair will be taken by Sir John Lubbock, Bart., D.C.L., F.R.S. An address will be delivered by Prof. W. H. Corfield, M.A., M.D., entitled "The Water Supply of Ancient Roman Cities."

THE new buildings which have been [illegible] Chancery Lane and [illegible] Lane for the purposes of the Birkbeck Literary and Scientific Institution were [illegible] on Saturday afternoon by the Prince of Wales. The buildings, of which the foundation-stone was laid [illegible] Duke of Albany, [illegible] the first floor [illegible] the library, reading [illegible] the [illegible] has been [illegible] on the [illegible] the purposes for which they [illegible].

[illegible] Capt. R. Nixon [illegible] Royal [illegible] A sum of 250l. has been [illegible] valuable [illegible] observations during the [illegible]. A sum of money [illegible] early during [illegible] parts of [illegible] in the [illegible] on the fresh [illegible] to be [illegible].

THE Swedish [illegible] A. W. Ljungman [illegible] the study of the [illegible] west and south coast of Sweden, and [illegible] collected.

A [illegible] was observed at [illegible], near Stockholm, on the night of June 5, at 11.51 p.m. It came from the south, and [illegible] a straight line westward at about the height of [illegible] the horizon. It could be followed with the eye [illegible] between [illegible] and Algol, where it disappeared. The [illegible] of that of the moon, and [illegible] white.

A [illegible] are of a very disquieting [illegible]. Of the bodies of those killed by the avalanches in February last, twenty-four have been recovered, and the authorities have prohibited rebuilding in the valley. The weather during the spring has been exceedingly bad, snow falling incessantly from May 18 till June 5, and although the [illegible] the fishing has in consequence been very bad. Agriculture and cattle-grazing are also very backward in consequence of cold winds and night-frost. In many places cattle have died from starvation, and if things do not soon mend there will probably be famine in the island next winter. In some valleys the snow was 30 feet in depth in the middle of June.

WE have received the report of the Liverpool Naturalists' Field Club for the year 1884-85. Steady, quiet prosperity appears to be the order of the day in this and similar associations in this country and in America. An elaborate system of prizes has been carefully organised, and the society appears exceptional in this respect. The report of the committee draws attention to the fact that in botany alone has much work been done; in the wide fields of zoology, geology, and microscopy little has been done. The presidential address is very interesting; it is called "Ornithopolis; bird-life under the shrubs, and what may be seen from my study chair." For the rest, there are the usual reports of excursions and of the evening meetings, and a list of books and scientific apparatus useful in the pursuit of natural history.

A SHARP shock of earthquake, accompanied by a loud rumbling noise, was felt at Kopreinitz in Styria on the night of June 28, which was followed by two others the following morning. Several houses were thrown down, and other damage done.

A NEW theory as to the origin and cause of earthquakes has been propounded by the Viceroy of the Chinese provinces of Shensi and Kansu. In a recent memorial to the throne, published in the *Peking Gazette*, this high official describes an earthquake which occurred on January 15 in various parts of Kansu, and summarises briefly the various reports which he has received on the subject relating to the motion, the damage done (which in some places was extensive), and the measures taken for the relief of the sufferers. He then proceeds to say that for years past earthquake shocks have been so frequent in these regions that people have grown quite accustomed to them; indeed, one officer informs him that in certain villages there were indications of a movement of the earth every night during the fourth watch, but these always ceased after a heavy fall of snow. The memorialist concludes by attributing the earthquake to the mildness of the winter, which caused an excess of the *yang*, or male element of Nature; "but it was due in a measure also to the perfunctory performance of their public duties by the local officials, who thereby failed to call down the harmonising influence of Heaven, and the memorialist can only endeavour to remedy this fault by encouraging his subordinates to cultivate habits of introspection and examination of their own shortcomings, himself setting the example."

ON the morning of June 15 a lovely mirage was seen at sea from Oxelösund, in Sweden, representing two islands, covered with trees, on one of which there was a building. Two monitors were seen steaming off the islands. It may be of interest to add that two Swedish monitors are at present cruising in the Baltic, and were about that time several degrees further north.

THE second annual issue of the "Year-Book of the Scientific and Learned Societies of Great Britain and Ireland" (Griffith and Co.) has appeared. We must still express surprise at finding the Royal Institution placed alongside of the Royal Society as a scientific society, while the London Institution is omitted entirely. A list of the papers read at the various societies is given this year; but it is difficult to see what purpose the publication serves in its present form.

HERR J. MENGES describes, in a recent number of *Globus*, the language of signs employed in trade in Arabia and Eastern Africa. This appears to have been invented to enable sellers and buyers to arrange their business undisturbed by the host of loafers who interfere in transactions carried on in open markets in Eastern towns, and it enables people to conclude their business without the bystanders knowing the prices wanted or offered. It is especially in use in the Red Sea, and its characteristic is that beneath a cloth, or more generally part of the unfolded turban, the hands of the parties meet, and by an arrangement of the fingers the price is understood. If one seizes the outstretched forefinger of the other it means 1, 10, or 100; the two first fingers together mean 2, 20, or 200; the three first, 3, 30, or 300; the four, 4, 40, or 400; the whole hand, 5, 50, or 500; the little finger alone, 6, 60, 600; the third finger alone, 7, 70, 700; the middle finger alone, 8, 80, 800; the first finger alone and bent, 9, 90, 900, while the thumb signifies 1000. If the forefinger of one of the parties be touched in the middle joint with the thumb of the other, it signifies ½, and if the same finger is rubbed with the thumb from the joint to the knuckle it is ¼ more, but if the movement of the thumb be upward to the top instead of downward to the knuckle it means ¼ less. An eighth more is marked by catching the whole nail of the forefinger with the thumb and finger, while the symbol for an eighth less is catching the flesh above the nail—*i.e.* the extreme tip of the finger in the same way. It will thus be seen that, by combinations of the fingers of the seller and buyer, a large range of figures can be represented. It is, of course, understood that average market value of the article is roughly known and that there can be no confusion between, for example, 1, 10, 100, and 1000. This language of symbols is in universal use amongst European, Indian, Arab, and Persian traders on the Red Sea coasts, as well as among tribes coming from the interior, such as Abyssinians, Gallas, Somalis, Bedouins, &c. It is acquired very rapidly, and is more speedy than verbal bargaining; but its main advantages are secrecy and that it protects the parties from the interruption of meddlesome bystanders, who in the East are always ready to give their advice.

THE additions to the Zoological Society's Gardens during the past week include a Collared Peccary (*Dicotyles tajaçu* ♂) from South America, presented by Mr. R. Forrester Daly; a Common Peafowl (*Pavo cristatus* ♂) from India, presented by Mrs. Courage; two Black-bellied Sand-Grouse (*Pterocles arenarius* ♀ ♀), two Bonham's Partridges (*Ammoperdix bonhami* ♂ ♂) from Asia, presented by Mr. W. E. R. Dickson; a Siamese Blue Pie (*Urocissa magnirostris*) from Siam, a Hunting Crow (*Cissa venatoria*) from India, presented by Mr. C. Clifton, F.Z.S.; two Rooks (*Corvus frugilegus*), British, presented by Mr. C. A. Marriott; a Lion (*Felis leo* ♀) from Africa, a Great Kangaroo (*Macropus giganteus*) from Australia, a Grand Eclectus (*Eclectus roratus*) from Moluccas, a Red and Yellow Macaw (*Ara chloroptera*) from South America, deposited; a Striated Coly (*Colius striatus*) from South Africa, purchased; a Mule Deer (*Cariacus macrotis* ♂), a Mesopotamian Fallow Deer (*Dama mesopotamica*), born in the Gardens.

## *OUR ASTRONOMICAL COLUMN*

THE COMET OF 1472.—M. Celoria of Milan has discussed the elements of the last comet observed by Toscanelli, which is the celebrated one of 1472, also observed by Regiomontanus, whose description of its path in the heavens enabled Halley to make a rough approximation to its orbit, as he states in his "Synopsis of Cometary Astronomy." The Chinese account of the Comet's track contained in the supplement to the great collection of Ma Twan Lin, of which Edouard Biot published a translation in the appendix to the "Connaissance des Temps" for 1846, enabled Langier to make a further calculation of the orbit, though the somewhat full description of the comet's course amongst the stars is unfortunately very deficient in dates.

M. Celoria remarks that possibly from the advanced age which Toscanelli had attained, and the inclement season at which the comet was visible, the Florentine astronomer has not left for the comet of 1472 a representation of its track relatively to the stars as he has done for those of 1433, 1449, and 1457, nor an ephemeris of positions as in the case of the comet of Halley at its appearance in 1456; but two pretty definite places are assigned in Toscanelli's manuscript for January 9 and 17, and with the help of provisional elements a third position for January 22 is deducible. Still, in determining the most probable orbit, M. Celoria has found it desirable to utilise the one definite observation on January 20 which has been left by Regiomontanus. The principal available data are:—

| Paris Mean Time | Comet's Longitude | Comet's Latitude |
|---|---|---|
| | ° ′ | ° ′ |
| January 9·6326 | 193 0 | +13 0 |
| 17·6007 | 190 20 | 26 30 |
| 20·4021 | 185 12 | 46 3 |
| 22·2347 | 110 30 | +80 32 |

Two orbits result from the discussion of these positions, and M. Celoria concludes that it is difficult to decide which is preferable. These orbits are as follows:—

| | Orbit II. | Orbit III. |
|---|---|---|
| Perihelion passage Paris mean time | 1472. Feb. 29·89097 | Feb. 29.94555 |
| | ° ′ ″ | ° ′ ″ |
| Longitude of perihelion | 39 14 56 | 39 46 27 |
| ,, ascending node | 296 7 49 | 285 53 25 |
| Inclination | 14 11 46 | 9 9 54 |
| Log perihelion distance | 9·68072 | 9·68654 |

Motion—Retrograde.

Both sets of elements have the degree of precision compatible with the nature and number of the observations, and beyond doubt afford a closer approximation to the true orbit than either of the previous computations. Perhaps we may attach a slightly greater weight to M. Celoria's orbit II., from which it appears that the nearest approach to the earth took place at midnight on January 22, when the comet in right ascension 293°·5 and declination +76°·6 was distant 0·0652, with an apparent motion of 40° of a great circle daily. On this day Toscanelli refers to the interference of moonlight, and it appears certain that the presence of the moon must have greatly diminished the imposing aspect of such a comet while in the earth's vicinity. In fact we find that the moon was at the first quarter on January 18, and consequently at full soon after the nearest approach of the comet, when the theoretical intensity of light was one hundred times greater than at the end of the first week in January.

One of the European chronicles dates the first appearance of the comet on December 25, 1471, when it will be found from elements (II.) that it was in right ascension 194°·4, declination +5°·5 at 6 a.m. in London; intensity of light, 0·38. In a quaint description of the comet's track by John Warkworth, Master of St. Peter's College, Cambridge, and a contemporary, which was published in the *Philos. Mag. and Journal of Science*, vol. xiv. (1839), we read: "And some men saide that this sterre was seen ii or iii oures afore the Sunne rysynge in Decembre iiij days before Chrystynmasse in the Southwest . . . ;" calculating for 6 a.m. on December 21 we find the comet was in right ascension 193°·8, declination +5°·2: it would consequently be near the meridian two hours or so before sun-rise, instead of the western quarter of the sky. It is clear that as regards position it might have been found three weeks earlier than Toscanelli's first observation. Warkworth says the comet disappeared on February 22. The Chinese saw it on February 17 approaching one of their constellations composed of α, δ, &c., in Pisces, and it is added in Biot's translation "elle fut longtemps à s'effacer;" calculation gives the place in right ascension 11°·9, declination +0°·7, intensity of light 3·3, in the early evening at Pekin on that date.

M. Celoria's notice contains the geocentric track of the comet, according to both sets of elements, from January 9 to February 27. There is some reference in Pingré to a comet at the beginning of May, 1472, when the comet of Regiomontanus and Toscanelli would rise in Central Europe before 2 a.m., with an intensity of light about equal to that it possessed at the previous Christmas.

## *ASTRONOMICAL PHENOMENA FOR THE WEEK*, 1885, *JULY* 12–18

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on July 12*

Sun rises, 3h. 59m.; souths, 12h. 5m. 20·7s.; sets, 20h. 11m.; decl. on meridian, 21° 56′ N.: Sidereal Time at Sunset, 15h. 35m.

Moon (New on July 12) rises, 4h. 31m.; souths, 12h. 20m.; sets, 20h. 2m.; decl. on meridian, 16° 47′ N.

| Planet | Rises | Souths | Sets | Decl. on meridian |
|---|---|---|---|---|
| | h. m. | h. m. | h. m. | ° ′ |
| Mercury | 5 18 | 13 14 | 21 10 | 20 23 N. |
| Venus | 5 35 | 13 25 | 21 15 | 19 30 N. |
| Mars | 1 28 | 9 40 | 17 52 | 22 54 N. |
| Jupiter | 8 5 | 15 4 | 22 3 | 10 52 N. |
| Saturn | 2 32 | 10 42 | 18 52 | 22 32 N. |

*Occultation of Star by the Moon*

| July | Star | Mag. | Disap. | Reap. | Corresponding angles from vertex to right for inverted image |
|---|---|---|---|---|---|
| | | | h. m. | h. m. | ° ° |
| 18 | *m* Virginis | 6 | 10 10 | 10 27 | 184 215 |

*Phenomena of Jupiter's Satellites*

| July | h. m. | | July | h. m. | |
|---|---|---|---|---|---|
| 13 | 20 50 | II. occ. disap. | 15 | 21 15 | I. tr. egr. |
| 14 | 21 38 | I. occ. disap. | | | |

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

| July | h. | |
|---|---|---|
| 13 | 12 | Mercury in conjunction with and 5° 39′ north of the Moon. |
| 13 | 15 | Venus in conjunction with and 5° 22 north of the Moon. |
| 15 | 7 | Jupiter in conjunction with and 3° 7′ north of the Moon. |
| 17 | 14 | Mercury in conjunction with and 0° 11′ south of Venus. |

## *GEOGRAPHICAL NOTES*

Dr. Gottsche, formerly a professor in the University of Tokio, has, as we have already intimated, returned to Europe after a long journey in Korea, during which he acquired much information with regard to that country. The length of his journey was over two thousand miles, and he visited all the eight provinces of Korea, as well as 84 out of the 350 districts. The main object of Dr. Gottsche's explorations was to ascertain whether coal and other useful minerals existed in the country; but, on account of influential support which he received he was able to obtain from the native authorities information with regard to the population, taxation, harvests, trade, &c. He has also collected much statistical information which is wholly new and which it is expected will show that the recent English consular reports are quite incorrect. Amongst others the population of the peninsula has been greatly underrated. It has generally been put down at nine millions, whereas it really is over twelve millions, for the official census from which the former estimate is taken only takes into account adults. Dr. Gottsche's principal stations on the journey were Soul, Ichhon, Kwisan, Mangyong, Kyongyn, Pusan, Changwön, Cwangyn, Chinsan, &c. He was 138 days *en route*, and, although this was not rapid, he was compelled to neglect some branches of investigation, such as botany and zoology, for his main business was with geology. In this respect Korea appears to belong to the bordering Manchuria. He found but few traces of the high development which the art and science of the country reached in early ages, and which made it the instructress of Japan. Dr. Gottsche, it is said, intends publishing an account of his journey.

Prof. Blumentritt, in an article in *Globus* on the Negritos of the Philippines, points out that the notion which was general at one time that these aborigines of the Archipelago were almost extinct, or absorbed into the Malay population, is an error. It may be said with certainty that they no longer exist in the Babiuyanes, Batanes, and other groups lying to the north of Luzon: but we know too little of the interior of Sámar and

Leyte, as well as of the great island of Mindoro, to say this. We know from Montano's explorations that they live in great numbers in Mindanao and elsewhere; but nevertheless, the *Negrito puro* sooner or later adopts the dress and customs of his Malay conqueror. All the efforts of the Spanish Government and of the Catholic missionaries tend to efface the peculiarities of the Negrito; and the Professor therefore states that, before it is too late, some scientific traveller should visit Mindanao to study the Atás and Mamanuas thoroughly; likewise an investigation of the Negritos of Panay and Negros is much to be desired.

M. Le Monnier contributes to the last number of the *Deutsche Rundschau fur Geographie*, &c., an article on the Island of Hainan, off the coast of China, to which some attention was recently directed on account of the rumoured occupation of it by the French. It has been known to the Chinese since 110 B.C., but it was not till the 13th century that it received its present name. From the earliest times to the present the aborigines, the Li, who inhabit the mountains in the centre, have maintained a struggle against the Chinese. It is even less known than Formosa, for no Europeans have travelled in it. One port, Kiungchow, has recently been opened to foreign trade, the north and south coasts have been surveyed, but there is no survey of the east coast. As to size, it is a little smaller than Formosa, and is larger than either Sicily or Sardinia. The centre is exceedingly mountainous, and from it rivers radiate in all directions to the sea. It is so near the mainland that its flora and fauna are in all respects continental. The direction of the mountain system is from south-west to north-east. Volcanoes have been examined there, but they appear to be now extinct. Earthquakes are frequent. As in Formosa, the population consists of three elements—the Chinese, the subjugated and the independent natives. Amongst the former are the Miaotsze, who have crossed over the narrow strait from time to time from Kwangsi and Western Kwangtung, and have taken possession of some of the smaller hills. Their language is said to be similar to that of the Li; they are good husbandmen, and are on friendly terms with both the Li and the Chinese. The independent Li appear to be an aboriginal race which has been driven back to the hills by the Chinese immigrants. Information with regard to them is very scanty, but they appear to have a reddish skin and to be of small stature; their language resembles that of the Miaotsze of the mainland. The women are tattooed after their marriage, and they paint their faces with indigo. The Li are expert hunters and shots; the weapons are bamboo bows and arrows and a short sword in a sheath. The main sources of information with regard to Hainan are a paper by the late Mr. Mayers in the *Journal* of the North China Asiatic Society (No. vii., 1873); one by Mr. Swinhoe, entitled "Narrative of an Exploring Visit to Hainan," in the same periodical (No. vii., 1871-2); and a map of the Kwangtung Province, and other publications by Dr. F. Hirth.

Herr Glaser, the Arabian traveller, has returned to Arabia to resume his explorations. This second journey is to be mainly geographical, but archæology will also receive attention. Besides visits to Marib and Nejdran, Herr Glaser contemplates a long journey through the interior from Hadramant to Omaun, and a second across South Arabia.

M. Baux, member of the Geographical Society of Paris, has been despatched on an ethnographical mission to China; and M. Guerné proceeds to Kiel to take part in the labours of the commission for the scientific examination of the German coasts. These missions are undertaken by direction of the Minister of Public Instruction of France.

Prof. Seelstrang, of the University of Cordoba, has been appointed by the Argentine Government to superintend the publication of an atlas of the Republic, and a considerable sum has been appropriated for the work. It is to consist of twenty-seven parts, and four of these are already in hand.

At the last meeting of the Geographical Society of Paris, M. Alphonse Milne-Edwards in the chair, M. de Saint-Pol-Lias, who is now in Cochin China, presented a map of the upper course of the Red River, prepared by the Annamites. Another map of importance is that of the navigable water-ways of southern Indo-China, prepared by M. Rueff, who has established a company for navigating these waters. A letter was read from Jeddah stating that the collections of the unfortunate M. Huber, including his remarkable examples of Semitic epigraphy, were safe in the hands of the French Consul, and that the explorer's remains were buried in Jeddah on May 27.

The last number (Band viii. Heft 2) of the *Geographische Blätter*, published by the Bremen Geographical Society, contains a study on the Congo region by Dr. Oppel, dealing with the scientific and economical importance of this district. The paper is divided into two main sections: (1) The discovery and investigation of the Congo (*a*) between 1484 and 1872, (*b*) the systematic exploration since 1872; (2) The extent and boundaries, geology, &c., of the Congo region. Prof. Seelstrang writes on the Argentine province of Buenos Ayres, its geography, fauna, flora, climate, inhabitants, trade, industry, &c., in short, a kind of encyclopædic article on the province. Another paper on South American geography, or rather geology, is that by Dr. von Thering on the Lagoa dos Patos, in the province of Rio Grande do Sul, the largest lake in Brazil This is accompanied by a map of the extent of the sea in the province at the beginning of the alluvial epoch. Herr Zöller writes on the Batanga River; the number also contains a report of the late *Geographen-tag* at Hamburg.

## ON A RADIANT ENERGY RECORDER

Sunshine-recorders may be divided into two classes, viz., those which roughly measure solar energy by the burning of card and wood, and those which, by means of some photographic process, yield a record of the relative intensity of some more or less definite ray. The principle of the instrument which I am about to describe differs from those referred to in this respect—that it depends upon the evaporation of water *in vacuo*, and its indications are therefore readily expressible in heat-units.

The form of instrument with which I have sought to test the applicability of the method consists of a Wollaston's cryophorus (of the form pictured in Ganot's "Physics," p. 272, edition 1872), in which the vertical tube and lower bulb are replaced by a simple glass tube graduated in cubic centimetres. The bulb containing the water to be evaporated is blackened by holding it in the smoke of burning camphor, and is then exposed to the sun, the rest of the apparatus being silvered or properly protected by bright sheets of tin. At sunset the quantity of water which has distilled over can be read off on the graduated tube.

An experiment on June 6 showed 1·8 cc. to have passed over from a bulb of about 2 inches in diameter, and to have condensed in a narrow measuring tube between the hours of 10.40 and 3.20. The instrument seems very sensitive, and may well find many applications. In a suitable form of instrument the total nett solar energy gained by the blackened absorbing surface will be almost exactly represented in heat-units by multiplying the number of cubic centimetres of water distilled by the latent heat of steam. To measure the loss of the earth's radiation at night a similar instrument containing alcohol or some other liquid of low freezing-point might be employed. In either case, when a continuous time record is required, the graduated tube might be used as a cylindrical lens to condense light on photographic paper.

The following are the more important conditions which the apparatus in a future form should probably fulfil:—

(1) To present a constant and known absorbing surface to the sun.

(2) To preserve a constant surface for evaporation which should be the same in the condenser, so that a reversal of the direction of distillation can take place under the same conditions when the black bulb is losing energy.

(3) To give rise to the minimum of reflection and convection currents on the absorbing surface.

(4) The apparatus should be so screened as to be at the temperature of the air apart from the gain of energy at the blackened surface.

Some of these conditions seem likely to be more or less fulfilled in an apparatus consisting of two glass bulbs of equal diameter connected together by a tube bent through an angle of about 150°, to bring the bulbs near together, and thus keep them in air of the same temperature. In the bulb containing the water to be evaporated, a black bulb might be fixed to absorb the solar radiation, whilst to the upper part of the second bulb should be sealed a graduated tube in which the distilled water might be measured by inclining the instrument. If metal globes were employed the connecting tube might be made to form the beam of a balance.

The completion of other work will prevent my return to this subject at present—perhaps altogether—but I have ventured to publish this incomplete account of an apparently promising method for the measurement of solar radiation, in the hope that it may be of use and interest to others.

University College, Liverpool. J. W. CLARK

P.S.—It may perhaps be found advantageous to use an apparatus like an inverted cryophorus, in which the absorbed radiant energy generates a vapour-pressure, and is made to lift a column of water in the tube—the height of the column and the time being registered photographically.

## THE GROWTH OF CEREALS

PERHAPS nowhere is the influence of the different climatic factors on the rapidity of growth so well illustrated as on the plains of Russia. Therefore W. Kowalewski's careful researches into this subject, summarised in the *Memoirs* of the St. Petersburgh Society of Naturalists (xv. 1), are especially worthy of attention. The author has gathered all necessary information for showing the periods of growth of various cereals on the soil of Russia, from the far north of Arkhangelsk, to the southern province of Kherson, and he has arrived at most interesting results, of which the following is a summary. If the periods of growth of the same cereal be taken throughout Russia, it appears that, altogether, it is in the higher latitudes that it ripens fastest. Oats and spring wheat take 123 days and barley 110 days to ripen about Kherson, and only 98, 88, and 98 days at Arkhangelsk, the difference in favour of the north being respectively thus: 25, 35, and 12 days. The intermediate regions show also intermediate differences, while for each latitude the growth of cereals proceeds faster in the eastern parts of Russia than in the western. It is obvious that if the rapidity of growth were due to temperature, the phenomena would be the reverse of what they are. Moreover, the want of moisture in the southern steppes is also a condition in favour of the rapidity of growth: so that it is in the insolation that we must seek for the cause of the above-stated difference. In fact, oats being usually sown about May 17 at Arkhangelsk, and the harvest usually occurring about Sept. 1, the insolation continues there for 2000 hours in 98 days, not to speak of the 240 hours of bright nights; while at Kherson, during 123 days (from April 1 to Aug. 1) the insolation lasts only for 1850 hours. The difference in favour of Arkhangelsk is thus equal to 150 hours (to 400 hours, if the bright nights be added), and it compensates for the influence of temperature. It is useless to add, moreover, that the cereals cultivated in the north have already undergone a certain accommodation to their conditions. As to the intensity of light, Prof. Famintzin's work on the subject, corroborated by ulterior researches, shows that the great intensity of light in Southern Russia, combined with the great transparency of the atmosphere, is rather a condition against the rapidity of growth, the intensity of light exceeding the limits of the maximum of decomposition of carbonic acid. Winter rye shows the same differences as the spring cereals. It appears from M. Kowalewski's tables that in the Arkhangelsk district winter rye takes 375 days to arrive at ripeness, of which there are 202 days of winter rest, 68 days of autumn growth, and 105 days of spring and summer growth, making thus a total of 173 days of growth. At Kherson the total growth lasts for 290 days, of which only 101 days of winter rest and 189 days of productive growth (63 during the autumn and 126 during the summer). The difference reaches thus 16 days in favour of the north, and it would rise to 20 or 25 days if only spring and summer be taken into account. The graphical representation of all these data is most interesting. Thus the lines of simultaneous sowing of winter rye from north-west to south-east correspond to the isochimenes, while the lines of simultaneous ripening of the spring cereals—oats, barley, sarrazin, wheat—run from south-west to north-east, corresponding to the lines of equal summer temperatures. The retarding influence of rain comes out also pretty well.

## THE ROYAL SOCIETY OF NEW SOUTH WALES

THE annual general meeting of the members of the Royal Society of New South Wales was held on May 7. The president, Mr. H. C. Russell, B.A., F.R.A.S., occupied the chair, and delivered an address, from which we give the following extracts:—

"There is a very general impression, borne out by the evidence which geology has furnished, that at least the east coast, if not all Australia, is rising in relation to the mean level of the sea. The late Rev. W. B. Clarke, in a report to the Port Jackson Harbour Commission, said 'that the coast has risen in former geological epochs, and that it has risen during the present epoch is capable of distinct proof.' 'Raised beaches of shells, which are not kitchen middens, may be seen about twenty-five feet above the sea, near Ryde, on the Paramatta estuary, and at Mossman's Bay, in Port Jackson, at a height of 132 feet above high-water.' Again, 'regarding the whole coast from Broken Bay to Botany Bay as mere peninsulatic fragments, united only by low isthmuses, bare or covered with sand, as they actually are, one may still see that there must have been oscillations of level, and finally elevation.' Speaking of other portions of the coast, Mr. Clarke says:—'At Adelaide in 1855 the railway between the city and the port was being constructed, and Mr Babbage has since shown that in four years a difference of four inches of rise between the levels of those places has taken place. And again, 'according to Mr. Ellery, the accomplished and accurate Williamstown observer, the self-registering tide-gauge at that place indicated a rise of the bottom of Hobson's Bay of four inches in twelve months, and a deposit of recent shells and imbedded bones of sheep and bullocks which had been thrown into the bay is now seen at a level above the reach of the sides.' Again, quoting from a letter by the late Mr. John Kent, of Brisbane:—'A survey was made of a shelf of rocks in Brisbane River in 1842 by Captain Gilmore, Mr. Petrie, and myself, and in making a re-survey in 1858 Mr. Roberts found the relative depths were singularly correct, but that the general depth of water over the shelf of rock had decreased eighteen inches in sixteen years since the first survey was made.' Sir Roderick Murchison, in the *Proceedings* of the Royal Geographical Society of London (vol. vii. p. 42) quotes from a letter he had received from the late Mr. Kent, of Brisbane:—'I have lately drawn the attention of the Rev. W. B. Clarke to the fact that the eastern coast of New Holland is rising at the rate of (say) one inch per annum, as ascertained by the height of rocks in the river Brisbane above tide levels, through a period of twenty years, and he assures me that to the south the same result has been inferred, though the observations have not extended over so long a period. At what rate the rise is now going on there are no data to establish. Till a series of mean tidal levels are marked on the rocks of the harbour, and the alteration made as distinct as that in Hobson's Bay, any deduction as to the rate of rise must be conjectural and unreliable.' I have but taken a few extracts from a great mass of evidence which Mr. Clarke brought forward in proof of the rapid elevation of the coast of Australia. I was deeply interested in this report when it was published in 1866, and as soon as I had opportunity determined to make such observations with a self-registering tide-gauge as would determine the rate of rise, if any, and in collecting information bearing upon this subject during the past thirteen years. I wrote to Mr. Ellery and asked him for further particulars of the rise going on in Victoria, and in reply he said that Mr. Clarke had in some way misunderstood his remarks, which had reference to the silting up of the harbour, not the elevation of the land; and he at the same time sent me a copy of his paper on 'The Tidal datum of Hobson's Bay,' read before the Royal Society of Victoria, August 14, 1879. After giving the history of the tide-gauge, which was started in 1858 under the Harbour Department, and was not under his control till 1874, Mr. Ellery says:—'It is to be regretted that no precise references to mean tide level in the earlier days can be found. Where measurements do exist in Hobson's Bay they are lacking in accurate information as to the state of the tides, and I find nothing trustworthy upon which to base any statements as to change of sea level since surveys have been made. I think it desirable that permanent bench marks on the natural faces of the rock *in situ* should be established around our bay, carefully connected by accurate levelling with one another and with the tide-gauge, for it is very doubtful if bench marks on buildings can be assumed to afford a permanent datum.' The first self-registering tide-gauge in Sydney was erected on Fort Denison by the late Mr. Smalley in 1867. Unfortunately the design was so faulty that all the records of the heights of tides made by it are of no value, although the times of high and low water are correct. The reason for this fault in its records was that an ordinary hempen cord was used to connect the float and the pencil, and this gradually got longer by use, and also varied with the weather. Finding it impossible to remedy this fault satisfactorily in view of the necessity for exact records of the heights of the tides, in 1872 I had a new gauge made, which, without losing the accuracy of the time record, which the old one possessed, insured the correct record of the height of the tides. This instrument is figured and described in the 'Sydney Meteorological volume for 1878,' and to that work I must refer you for particulars. The record by the new gauge was begun on June 27, 1872, and at that time the precaution was taken of measuring the length of the chain connecting the float and the wheel, so that should any change take place its exact amount could be ascertained. The wisdom of this has been evident on several occasions when the chain was broken by accident, and the exact length restored. The well made for the tide gauge is in part cut in the solid rock, and from the rock to the surface of the ground the sides of the well are built up (round) with solid masonry, so that the top ring of the well is practically part of the solid rock, and cannot move unless the rock does so. On this ring the frame of the tide gauge stands, and the instrument, therefore, has a permanent relation to the rock, and there can be no change in its parts which might be mistaken for a change in sea level. I have been particular in detailing the conditions under which the tide measurements have been made, to show you that sufficient precautions to ensure accuracy have been taken. In each year the mean of all the tides is taken as the mean sea level for that year, and when these results for the past twelve years are placed side by side, it is at first sight rather puzzling, for although the greatest departure from the mean of all is only one inch, yet within this small range the land seems to rise and fall in an erratic way. The cause of these variations, however, was found in the varying relative positions of sun, moon, and earth, and perhaps, to some extent, in the effects of heavy gales. Taken as a whole, these results seem to prove conclusively that no change whatever has taken place in the relation of land and sea during the past twelve years. Of course the question is not settled—a slow change that would be visible in centuries might be altogether hidden in the results before us; but so far as they go these results will be interesting to scientific men, for they are the first that have been taken with such accuracy as the investigation demands. Mean Sea Levels: 1873, 2 feet 5·9 inches; 1874, 2 feet 7 inches; 1875, 2 feet 6·3 inches; 1876, 2 feet 5·5 inches; 1877, 2 feet 6·7 inches; 1878, 2 feet 6 inches; 1879, 2 feet 5·5 inches; 1880, 2 feet 6·2 inches; 1881, 2 feet 5·2 inches; 1882, 2 feet 6·1 inches; 1883, 2 feet 6·8 inches; 1884, 2 feet 6·95 inches—2 feet 6·11 inches. In examining this question I looked for some mark of old surveys which might show what the evidence of a longer period would be, but I have failed to find any mark put in with such care as the investigation demands. There is, however, one mark on the north-east face of the round tower on Fort Denison which was put in by H.M.S. *Herald* during her survey of Sydney harbour. It is cut in the stone three feet above mean sea level, and is marked with the broad arrow under it. I have been at some trouble to find out on what observations this mark was based; but although I have learned that the survey was made in 1857, and that the *Herald* was in port from February 26 to December 21, 1857, I cannot learn how long the tide observations were continued, but I hope still to do so. The time and method of taking mean sea level might account for a difference from the true mean of four or five inches, as is shown by the different monthly means from the recording tide gauge, and until I can learn on what observations the *Herald's* mark depends, it cannot be used as evidence of change of level of the land. I have, however, connected it carefully with the zero of the tide gauge, and if it exactly represents mean sea level in 1857, it proved that the land has risen five inches in twenty-seven years; but, since the tide gauge shows no change whatever during twelve of these years, I think the evidence of the mark cannot be taken without full particulars of the observations on which it depends. In the course of conversation with the late Rev. W. B. Clarke on the question of the elevation of the coast, he pointed out to me evidence not only of the elevation of this coast, but also of its subsidence, and expressed his conviction that Port Jackson, Hawkesbury River, and other places on the coast had been cut out by the action of fresh water, when the coast was much higher than it is at present—in fact, that these inlets had been at one time gullies exactly similar in character to those which now exist in the Blue Mountains, and which have been so obviously cut out by fresh water. Since that time many bridges have been made along the coast, and the borings made for foundations for these bridges have special significance in connection with Mr. Clarke's opinion; and by the kindness of the Engineer-in-chief for Railways and the Engineer-in-chief for Roads and Bridges I am able to quote here some of these measures, which prove conclusively that the sea was at one time much lower than it is at present. The soundings taken for the Parramatta Railway bridge show 26 feet water, 32 feet mud and silt, 8 feet loose sand, 12 feet hard sand, 10 feet loose sand: total, 88 feet. George's River bridge—8 feet water, 87 feet mud and sand, 9 feet black clay, 16 feet sand, 4 feet hard sand: total, 121 feet. Hawkesbury River bridge—44 feet water, 31 feet light mud, 87 feet black mud, 8 feet very hard sand: total, 170 feet. In the road-bridge over the Parramatta River—41 feet water, 16 feet shells and mud, 15 feet sand, 9 feet blue clay, 6 feet clays and shells: total, 87 feet. Ironstone Cove road-bridge—26 feet water, 7 feet stiff blue clay, 36 feet very stiff blue clay, 15 feet yellow clay, 5 feet stiff black clay, 11 feet sand and clay, 2 feet clean sand, 3 feet gravel and wood: total, 105 feet. Shoalhaven River road-bridge—14 feet water, 103 feet mud and silt: total, 117 feet. The bottom of the Hawkesbury, therefore, where the railway-bridge is to be, is 170 feet below the level of the sea to-day; and when the rocks were washed away to form the river-bed to that depth, the sea must have been at least 170 feet below its present level, and the bearings in Sydney Harbour and George's River indicate a similar fact, if not to the same extent. Without going further into this question, which is foreign to my present purpose, I think I have said enough to show that the evidence for elevation and subsidence of the land are about equal, the question before us being, In which direction is the change going on now? In estimating the value of the evidence quoted as to the rate of rise in Queensland and South Australia, we must not forget that when engineers adopt the usual rule as to mean sea level—that is, as to the mean of high and low water at any time of the year—they assume that all such means are equal or represent a constant level, when in point of fact two such determinations of sea level may differ by 8 inches or even more, and in the absence of a self-registering tide-gauge, or constant observations extending over a year, no levelling referred to the sea in the usual way is of any value whatever in such an investigation as that required to determine whether the relative level of land and water varies. I have already shown that Mr. Ellery thinks there is no evidence of present rising in Hobson's Bay, and the fact that at the time the engineering levels referred to were taken in South Australia and Queensland there were no self-registering tide-gauges to determine accurately mean sea level, is sufficient to warrant us in hesitating before we receive the evidence as to the rate of elevation furnished from these colonies, which I quoted from Mr. Clarke's report. Some few months since it occurred to me that it would be desirable to put a self-recording gauge on Lake George, with a view of keeping a continuous record of evaporation and other changes of level in it; and as soon as the instrument could be got ready I put it up on the west side of the lake, in front of Douglas House, which is about a mile from the present southern end. The work of erecting the instrument was completed on the afternoon of February 18, and the pencil was put down on the paper to begin its curious record at 7 p.m. on that day. At the time the lake seemed calm as a millpond, and, looking at its smooth surface, no one would have dreamed that such changes were going on in it as began to reveal themselves so soon as the pencil touched the paper, and in two hours the pencil had recorded a rise and fall of about 2 inches. This is not a motion like the ordinary wind-made waves, which pass by in two or three seconds, but a slow and gradual rise, occupying an hour, and then a corresponding fall in about the same time, to do which a current must first have set from north to south for an hour, and then reversed; and if we consider for a moment the force necessary to put a body of water 18 miles long, 5 wide, and 15 or 20 feet deep, in such motion, we shall get some idea of the magnitude of the forces at work. The record had not been going 24 hours when it became obvious that these periodic motions in the level of the water had a period of about two hours, and on the afternoon of the second day a heavy thunderstorm passed over the south end of the lake, and threw a little light on the cause of the pulsations. The storm rain was very heavy and much of it must have run into the lake, tending to raise the waters there. With the storm there came a violent squall of wind from the south, on to the south end of the lake; in a few minutes great foam-crested waves could be seen in the middle, and the recording gauge at once showed what was the matter; the wind had blown the water away from the south end and reduced the general level 3 inches. In 10 minutes the squall was over, and the water began to recover its level, in doing which the current set towards the south end of the lake, and could be seen running past the jetty at the rate of about two miles per hour. But it did not stop when the old level was reached, the momentum carried it beyond that point, and raised the water up at the south end of the lake. Then it turned and ran back again, repeating this process time after time at intervals of about two hours, the rise and fall getting gradually less until in about eight hours the water was almost still, when suddenly, at 11.30 p.m., the water began to rise faster than ever, and in 30 minutes had risen 4 inches; it then turned and fell nearly as fast as it had risen, and reached its lowest point in 1 hour 41 minutes, having fallen exactly 6 inches. At Douglas House the night was fine and calm, without the sign of a storm. Yet it seems probable that a storm passed over the north end of the lake, and started the motion, which kept on at intervals of about two hours for 14 hours, the rise and fall gradually getting less. I was fortunate enough to be present and see so much of the record and the corresponding weather. You have no doubt noticed that one set of pulsations was started by a sudden fall, and the other by a sudden rise, in the lake, and that the impulse which caused the water to rise was greater than the other. Similar impulses have kept the lake in almost constant motion ever since, and when once under way, they will go on throughout a gale of wind with just as much regularity as in a calm. Ordinarily each a set of motions lasts 10 or 12 hours, decreasing gradually as if the friction of the water stopped it; but on several occasions they have kept on for days together. The most remarkable impulse yet recorded was on the 24th of April, when the water was remarkably still, and had been so during the 11th, 12th, and 13th. At 11 a.m. on that day Mr. Glover, who has charge of the gauge, saw a thunderstorm coming down from the north, and went into the recording-house to see its effect. The lake was rising fast, and in 30 minutes rose 4 inches; as the storm passed overhead the rising ceased, and the lake at once began to fall, getting back to its previous level in 15 minutes; passing this point it fell 2 inches more—in all 6 inches—and then began to rise again, so starting a series of pulsations that lasted five days. Rain came with this storm, and on the 24th and 25th measured by gauges at each end of the lake 1·10 inch rain fell, and this caused a rise of 1½ inches in the lake, which can be distinctly seen in the record as something independent of the pulsations. With the rain there was a strong breeze of wind, and by the third day after the water had returned to its old level, all the rain having evaporated in three days. In each of the cases I have mentioned so far the impulses seem to have been given by a sudden storm breaking over the lake, but there are other instances in which the impulse was of a totally different character, and it seems as if a small force properly managed was enough to do duty for a large one, just as we should set a heavy weight suspended by a string in motion by giving it first a little push, and then adding impulse at each swing. So the force, whatever it be, which in these cases acts on the water in the lake, gives it a little start and gradually gets it in motion. The best instance of this occurred on the afternoon of April 5, at the time the lake was very quiet, and suddenly the water rose an inch, and fell again within 30 minutes; next time it rose an inch and a half, and fell 2 inches in three quarters of an hour, the next time it rose 2 inches, and fell 3½ inches in an hour; it then rose 3½ inches in 40 minutes, and so started a series of pulsations which settled down to two-hour intervals, and lasted twenty hours. Generally, the rise and fall take about equal times, but now and then the whole fall will take place in 14 or 15 minutes, and the corresponding rise takes 116 minutes, and it is not very unusual [illegible] one in a set of two [illegible] the period of the others, as if one had been left out. In fact the variations in the [illegible] of vibration are very puzzling. With a view of finding out the most common period I have measured 54 of the best defined amongst those already recorded. Of these 33 have a period of 2 hours 11 minutes, five a period of 2 hours 5 minutes, [illegible] a period of 2 hours 17 minutes, and [illegible] a period of 1 hour 12 minutes. The periods of those on the Lake of Geneva are 72 minutes and 35 minutes. Of those in Lake George which have a period of 2 hours 11 minutes, some are the largest yet recorded, and others only a half or a quarter of an inch rise and fall; so that there must be something which makes or tends to make the period 2 hours 11 minutes. It is noteworthy that at Lake George as well as the Lake of Geneva, the short wave is not half the long one, but they bear about the same proportion one to the other in each case. As to the cause of these motions in the lake I am not prepared to say much at present. Further investigation is needed, and I hope, by the aid of a recording aneroid already there, and a recording anemometer to be erected shortly, to be able to compare the changes of wind and pressure with the changes in the lake; but I do not expect to find everything. Changes of level, &c., are going on in the earth surface, which, from an astronomical point of view, are intensely interesting, because they affect the instruments, and therefore the measures. They are very minute, and we have no means of keeping a continuous record of them; but it is possible that if such changes affect the lake they will be so magnified by its comparatively enormous extent as to show themselves on the recording instruments there. The barograph at Sydney has shown long since that thunderstorms come on with a sudden rise of the barometer, which at times amounts to a tenth of an inch. If such a change could affect one end of the lake for a few minutes it would be equivalent to putting suddenly on to it an inch of water, which would make itself known at once by a rush to the other end; but although such changes must have some effect I do not think it can be considerable, because, as I have elsewhere shown, these storms move at the rate of about 60 miles per hour, and are often 50 miles wide, so that such a storm coming on to the lake would spread all over it too rapidly to cause much motion in the water. I am here assuming that the storms there are of the same character as those which pass over Sydney, but they may be smaller when passing the lake, and travel more slowly. Certainly the storm which I saw coming down the lake did not travel with anything like such velocity. M. Vaucher, who studied for years the motions of the same kind which take place in the Lake of Geneva, considered himself justified in saying: "The lake is disturbed when the barometer is unsteady, and because of the varying pressure." From what I have seen so far, the first part of this is true of Lake George, but [illegible] is not because the barometer is unsteady, but because at such times the wind is puffy and variable, and imparts to the water its own peculiarity. Of the power of the wind [illegible] set the water in motion I have mentioned several instances to-night, which I need not repeat, but I may add that the large impulses come from the north, because, as it seems to me, the wind from that direction acting on the water, the whole length of the lake has greater power than when blowing from the south over a short stretch of water, the gauge is fixed about a mile from the south end. But, although the wind is such an obvious cause of the phenomena under discussion, I think the barometric changes have some share in it, and there are some changes recorded which, so far, I am unable to refer to any cause. Mr. Russell then entered into details of the surroundings of Lake George, which, he stated, are of very great interest, viewed in the light of discussions as to the possible change in the amount of rainfall in the colony during long periods. The persistence of level in Lake George, he pointed out, is very strong evidence in favour of the view that there has been no great change in the rainfall there for thousands of years, and probably the same may be said of Australia. The rainfall on the lake in 1870, Mr. Russell said, was 50 inches, double the average rainfall, which is 25 inches, and it is not to be wondered at that the lake rose at an unusual rate. Still the rain, heavy as it was, only served to cut little gutters in the older deposits which had been brought down the gullies. The primary object in placing the recording gauge on Lake George was to ascertain the rate of evaporation from such a large body of water, the conditions of the lake being very favourable for such an investigation. The record began on February 18, and the time since is too short to justify any assumption of the rate of evaporation there; but I may mention some of the facts that have been recorded bearing upon this question. In 68 days the period the lake has fallen 7 inches by evaporation; in this same period, according to the records of rain-gauges at each end of the lake, 3½ inches of rain has fallen, so that, ignoring the water which may have run from the hills during these rains, the lake has lost all the rain falling on it and 7 inches more, that is, 10½ inches. During the past 14 years the lake has lost by evaporation 12 feet; and in May, 1875, the railway survey carried down the western side showed that the lake was then

[illegible]

## VERSITY AND EDUCATIONAL INTELLIGENCE

[illegible]

## SCIENTIFIC SERIALS

[illegible]

## SOCIETIES AND ACADEMIES

LONDON

**Royal Society**, [illegible]

and a pair of [illegible] the [illegible] are indistinguishable from the three other like pairs, but are distinguishable from the two pairs formed by taking angular points at the extremities of [illegible] which pairs again are indistinguishable from each other. [illegible]

[illegible]

**Zoological Society**, June 16.—Prof. W. H. Flower, President, in the chair. [illegible]

[illegible]

paper by Mr. Sclater [illegible] the way in which [illegible] as observed in a specimen living in the Society's Gardens.—Mr. A. D. Bartlett read some notes on the [illegible] Chimpanzee [illegible] in the Society's Gardens, which he showed to be different from the ordinary Chimpanzee [illegible] [illegible] upon the Avian Sternum. [illegible]

**Geological Society**, June 10.—Prof. T. G. Bonney, F.R.S., President, in the chair.—Dr. A. G. Nathorst, of Stockholm, [illegible] Foreign Correspondent of the Society.—The following communications were read:—Note on the sternal [illegible] by J. W. Hulke, F.R.S., V.P.G.S. [illegible] of the neighbourhood of Haverford-west, by J. T. Marr, F.G.S., and T. Roberts, F.G.S.—On certain [illegible] by W. S. Gresley, F.G.S.

SYDNEY

**Linnean Society of New South Wales**, April 29.—[illegible], F.L.S., Vice-President, in the chair. The following papers were read:—Revision of the genus *Lamprima*, [illegible] new species, by William Macleay, F.L.S. Notes on the zoology of the Maclay Coast, New Guinea, by N. de Miklouho Maclay. [illegible] by N. de Miklouho Maclay. [illegible] Macleay Museum. [illegible] by the Rev. J. Milne Curran. [illegible] Hon. William Macleay. [illegible]

PARIS

**Academy of Sciences**, June 29.—M. Bouley, President, in the chair.—Remarks on [illegible] theory, and on two movements [illegible] by M. G. Darboux. [illegible] by M. Faye.—Remarks on the same subject by M. Mascart.—Researches on isomery in the aromatic series. Heat of neutralisation of the oxybenzoic acids, by MM. Berthelot and Werner.

[illegible]

...logical Society

[illegible]

Physiological Society

[illegible]

beautiful crystals, and, both in this connection as also in the form of hydrochlorate of gold and in its conjunction with hydrochloric acid, had been searchingly examined. This base, altogether different both in its quantities and in its composition from the bases hitherto known, was named "cadaverine." It increased in quantity with time while choline and neuridine diminished. Later on there appeared another new base which was also characterised by its hydrochlorates of platinum and gold, as likewise by its chemical composition, which the speaker called "putrescine." It was [illegible] in the form of [illegible] crystals [illegible] in the hydrochlorates of platinum and gold. [illegible]

[illegible]

cells, again, had granular protoplasm, and were either round, with a large round nucleus, or were more or less lengthened to the degree even of a filiform shape. To relate these different forms of the cells of the vitreous humour each to an integral characteristic difference in the species to which it belonged, was more than the speaker had been able to accomplish. Towards the solution of this problem farther investigations would be required. —Herr Aronsohn communicated the further experiences, which, in conjunction with Herr Sachs, he had collected relative to the heat-centre in the cerebrum, discovered by him last year. When on a perfectly definite part of the cerebrum he pricked with a needle so deeply as to touch the parts lying under the cortex, then he observed a rise of temperature in the rectum, in the muscles, and in the skin of from about 1 to 2 C. The prick had to touch the corpus striatum in order to produce a rise of temperature, and in point of fact it was only the median part of the corpus striatum which, on being touched, gave rise to this result. No other part, however nearly situated to this spot, could, on being touched, produce the rise of temperature. The increase of temperature continued for about three hours after the prick, and [illegible] when the wounding of the brain was [illegible]. Electrical stimulation of the same limited spot produced a similar result. Whether there were ganglions lying [illegible] which influenced the production of warmth, or whether [illegible] were touched, was a question which [illegible]. In order to ascertain the immediate cause of the increase of temperature, experiments [illegible] and determination of the area were [illegible]. These experiments showed [illegible] corpus striatum was pricked the [illegible] and the exhalation of carbonic acid were increased, and that the [illegible] was augmented. It was therefore [illegible] in the metabolism generally [illegible] which, in the opinion of the speaker, was due to the heightened innervation of the muscular system [illegible] electrical stimulation.

## CONTENTS

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# NATURE

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THURSDAY, JULY [illegible]

## *THE BIRDS OF LANCASHIRE*

[illegible]

to say [illegible] stu[illegible], and induces his fellow-subjects to break the law by the price he offers for his "rarities."

Passing to another part of our theme we wish to mention our author's remarks on the valueless nature of nearly all the ordinary record[s] with regard to the migrations of birds. Many we are sure must have felt the truth of the following statements; but we do not recollect having before seen [them] so explicitly set forth, and [we con]gratulate Mr. Mitchell on [illegible] importance. He says:—

"The first is, that very few of the observations, now so numerously made, as [to the] movements of summer migrants are worth anything at all [illegible] data are to be collected [illegible] the common [illegible] with those now being collected [illegible] information from lighthouses [illegible] In [illegible] appended [illegible] the [illegible] it will be necessary for the [illegible] to fulfil something like the following [illegible]: first, that he should be [illegible] secondly, that he should be [illegible] with the plumage of the birds [illegible] he [illegible] be able to recognise most of them [illegible] and be thoroughly acquainted with their [illegible] then [illegible] that he should have a knowledge of the [illegible] of [illegible] from the [illegible] Such a [illegible] [illegible]

[illegible]

Norfolk nearly one hundred years ago—and accordingl[y] a coloured figure by Mr. Keulemans of each of thes[e] species is introduced. Some carefully drawn illustration[s] of decoys, as well as several other ingenious modes o[f] netting or snaring wild birds, are also given, and thes[e] add not a little to the interest of the book; for, with th[e] exception of the plates in Rowley's not very accessibl[e] "Ornithological Miscellany," we are not aware of an[y] representation of the mode of capture by "fly nets," whi[le] we think neither the "douker-net" nor the "snipe pantle" has ever been figured before; and with respect to this la[st] term, which Mr. Mitchell derives "from the Anglo-Norma[n] 'panter,' a net or snare," we may observe that Olina [in] 1622, and Willughby after him, calls a certain kind of ne[t] used in taking starlings, woodcocks, and other bird[s] *pantiere*—a word which seems to exist now in Italian [as] *pantana*. Of course a work on the birds of Lancashir[e] could not be complete without a reference to Gerarde an[d] the Pile of Foulders, whereon barnacles turned to geese[;] but we [are] glad to see that Mr. Mitchell abstains from sneering at the old herbalist's credulity, as so man[y] modern writers have done, though we must point out [to] him that [illegible] to speak of a "bernacle as [a] species of mollusk" [illegible] somewhat vague if no[t] inaccurate [illegible]. Let us add that a map of th[e] [county] and, so far as we have tested it, an excellent inde[x] are among the merits of this satisfactory little book.

## A CATALOGUE OF CANADIAN PLANTS

[illegible] Natural History Survey of Canad[a] [illegible] Alfred R. C. Selwyn, LL.D., F.R.S., F.G.S., Directo[r] [illegible] Part II. Gamopetalæ By John Macoun, M.A., F.L.S., F.R.S.C. 8vo. [illegible] pp. Montreal: [illegible] Brothers, 1884.

A[illegible] catalogue [illegible]

[illegible]

the Canadian flora is how [illegible] into it that are not found in the [illegible] question of the characteristics of the [illegible] an flora was fully discussed by Dr. [illegible] ress to the biological section of the [illegible] at Montreal, which was published [illegible] ber, 1884, of the *American Journal* [illegible] f its leading characteristics [illegible] are the abundant development [illegible] and [illegible] at we must turn for full details [illegible] in application to the [illegible] instances of a [illegible] idely distant from [illegible] Cape Breton Island, [illegible] known on the American continent [illegible] is entirely absent. A [illegible] European plants, such as [illegible] Some British species [illegible] varieties mostly [illegible] types. Of plants [illegible] Europe and [illegible] at all points of [illegible]

[illegible]

## LETTERS TO THE EDITOR

[illegible]

### [illegible] of Dr. Rebeck [illegible] The Gavel and [illegible]

[illegible]

resist this inexorable enemy on the part of the shallow water denizens of the sea, or any encroachment on exposed areas during fine weather by animals unfitted to meet the storm will incur the penalty of death.

The prime necessity for every member of the littoral fauna is the power of resisting the attacks of waves; and every development and variation undergone by such littoral fauna must of necessity have been carried out under the immediate control of waves.

If, as Prof. Moseley tells us, it was in the "littoral zone" that all the main groups of the animal kingdom first came into existence, we may go further and say that these main groups were modelled by the reaction [illegible] upon those in their [illegible] brought into being by waves [illegible] tidal beat. Thus the entry [illegible] of evolution can be traced back directly, by the two-fold links of wind and wave, to the sun itself.

One point that I have not [illegible] is the [illegible] recorded by others, is the [illegible] that may be observed between waves and tide action. For example, [illegible] with a wide bathymetrical range [illegible] say, fifty fathoms, may even [illegible] the elaboration of a [illegible] form and sculpture, in the deeper water; whereas between tide-marks the two daily checks to growth arising from the fall of the tide would [illegible] any such variation in sculpture, and the shrunk form [illegible] lost [illegible] to the alongshore [illegible].

Moreover, as the form [illegible] tide-marks is often in conflict with [illegible] deeper water, the form of a species living between tide-marks might [illegible] from that of the same species frequenting deeper water. As a possible instance I would adduce the case of *Trochus zizyphinus* and *T. granulatus*. These gastropods have always, I believe, been considered distinct species, but I have [illegible] specimens from [illegible] fathoms, showing a distinct passage between the smooth *zizyphinus* and the sculptured *granulatus*, and this both in outline and sculpture.

I regret that I have been unable to obtain [illegible] of the intermediate forms [illegible] they came from [illegible] the [illegible] the other. It is, I think, evident that though *T. zizyphinus* can retain its form in deeper water, *T. granulatus* could not retain its symmetrical granulation and form were it to invade the tidal strand.

The variety of method exhibited by the littoral fauna in resisting wave-currents affords a most interesting subject of research. Take for instance an exposed ledge of rock—no hypothetical one—with sturdy limpets living on it, the fragile *Pholadidea papyracea* living in it, and the hardy little *Littorina obtusata* clinging to the sea-weed. A storm attacks the trio, and test their several methods of defence. The limpet is safe on the rock, the Pholadidea in it, and the Littorina, though at once washed off its feeble support, is safe, thanks to its solid shell, from the utmost violence of the storm. The tenacious hold of the limpet on the solid rock and the feeble adherence of the Littorina to the sea-weed indicate very opposite methods of meeting a common danger.

In conclusion I would put in a plea for working [illegible] of the sea in [illegible] of new [illegible]. When one sees [illegible] task such a fish [illegible] the ground with its fin spreading [illegible] ready to [illegible] swinging [illegible], one would like [illegible] very [illegible]. A [illegible] ing [illegible] and [illegible] the [illegible] the [illegible] appliances they [illegible] evading their most formidable enemy. ARTHUR R. HUNT

Torquay, July 6

## New System of Orthography for Native Names of Places

ALLOW me to offer a few remarks on the Royal Geographical Society's "New System of Orthography for Native Names of Places," [illegible] in your issue of July 2. The Society [illegible] the thanks of the public for grappling with the [illegible] inconsistent [illegible] of [illegible] names [illegible]. Attention was called by myself to this subject in [illegible] of May and July, 1884, and I can [illegible] to the vowel and consonant system suggested by the Society [illegible] to the retention of the [illegible] English letters—and [illegible] other [illegible].

The latter exception deals with the statement contained in paragraph (a) that "no change will be made in the spelling of names that have [illegible] by long usage familiar to English readers [illegible] Calcutta, Cutch, Celebes, Mecca, &c." Now, why make even these exceptions to the excellent rules laid down? Exceptions [illegible] instance, and in the cases of justifiable reforms prove more often than otherwise the means whereby the benefits of such reforms are frustrated altogether. A little more boldness by the Society in grasping the nettle is wanted; and while an improved [illegible] spelling would soon become familiar to the public, the help given by this concession to [illegible] would encourage reforms both here and in other fields. The attempt to consider the public convenience here illustrates, I believe, [illegible]; while the seeking to preserve historical spellings, as with other historical and venerable anachronisms, [illegible] that the progress of reform is continually becoming hide-bound and stunted, if not stopped altogether, by the impossible attempt to energise distinct stages of growth at one and the same time. It is earnestly to be hoped that the Geographical Society, upon whom the mantle of "Bahnbrecher" in spelling reform has suddenly fallen, will do the wise thing here, and boldly set its face against all "exceptions" to wholesome, profitable improvement.

The need for, [illegible] the influence on other departments of spelling reform, of bold action on the part of the Society is illustrated by the retention of the letter [illegible]. In any reform scheme of the spelling of English place-names the next urgent question to be [illegible] the abolition of this letter will stand in the fore-rank of improvements. Witness its mischievous working in "Bristol," "Boston," "Heaton" (Hayton in 1790), "Dated" [illegible] Hexham, Hunstable, &c." N.

July 9

## Recession of Niagara Falls in 133 Years

THE history of [illegible] given of the rate of recession was [illegible] if we [illegible] to the first accurate account, that of the Swedish traveller Kalm, in *Gent. Mag.*, January, 1751; since which the gorge has [illegible] been enlarged full 100 acres, and has [illegible] deepened many feet. In p. 16, col. 1, As he said [illegible] yet half a league above the beginning of the [illegible] place, . . . but higher up it is quite impossible [illegible] the waters, for two leagues and a half up to the great fall, being a *series of smaller falls*, one [illegible]." Now plainly this whole series have so levelled [illegible] the [illegible] falls now descend some 160 feet instead of the "137 feet" that he repeatedly maintained (col. 2, l. 1) to be the [illegible] engineers, "with mathematical instruments, [illegible]." But as for the plan, he is yet more definite (P. 16, col. 2, l. [illegible]): "The river (or rather strait) runs here from [illegible] to north-north-west, and the rock of the great fall crosses it, not in a right line, but forming almost the figure of a semicircle or horse-shoe." Prof. Tyndall has well remarked that the upper stream having probably been always much wider than the gorge, the chief fall has always been concave [illegible]. Kalm's view makes it appear very slightly so, and we know [illegible] very flat segment arc, by a perspective illusion, [illegible] thought semicircles or even "horse-shoes."

About the fall, in the middle of the river, is an island, lying [illegible] north-north-west, or parallel with the [illegible] about 7 or 8 French arpents [illegible]. The lower end of this island is just at the [illegible] of the fall." He proceeds to tell how this island, [illegible] has been the scene of the [illegible] of two Indians by two others. [illegible] "The breadth of the fall, as it runs in [illegible] about [illegible] arpents. The island is in the middle of the fall, and from it [illegible] each side is almost the same breadth [illegible] but in his engraving [illegible] half [illegible] the [illegible] at its lower end is two [illegible]. His view makes it [illegible] 137 feet."

[illegible] than 80, was plainly one where [illegible] the falls were [illegible]. Is there the least [illegible] than ever reduced Goat Island (now ten times larger [illegible]) to one tenth? But, [illegible] "Luna Island" [illegible] fall [illegible] feet long, and you will have the arc, [illegible] of Kalm's middle rock, barely 350 feet from the point Mr. Wesson marks, on Fig. 2, "New York Shore," and about as much from a Canadian point west-south-west of it. As for Goat Island, it cannot, in his time, have yet been [illegible] by the falls, but may be one of those the hunters had habitually visited above. His description can [illegible] plotted on this last survey that the amount of gorge [illegible] since 1750 should be knowable to an acre. The west [illegible], only slightly the larger, has ever since been widening [illegible] its edge, and getting more of the stream [illegible], comparatively stationary, retaining its height and [illegible] in volume, must dry up, and [illegible] part of New York State. [illegible]

## Sky Glows

Since the sunsets of 1883 and [illegible] there has been an abnormal glow both before and after sundown [illegible] nothing in the way of twilight effect [illegible] Monday evening, the 6th, when about 10 p.m. [illegible] silvery white cloud lay above [illegible] sky, which was rather low in tone and [illegible] were wave like in form, and [illegible] though they must have received their light from the [illegible] not easy to think so, as upon the dark sky [illegible] brighter and paler than clouds under a full moon. [illegible] who was with me aptly compared the light on them [illegible] that which shines from white phosphor paint. [illegible] for some time after 10 p.m. [illegible] the lower edge of the clouds, which was sharply defined, 12° above the horizon. [illegible]

[illegible] Place, Southampton, July 8

## Black and White

[illegible] daughter has two terriers, one black, the other white [illegible] that in the dusk of the evening the black dog [illegible] visible than the white one, and [illegible] asked me to [illegible] this fact. I cannot properly explain why a white [illegible] garment shows much less in the dusk than dark [illegible], but this is a well-known fact [illegible] ducks at night, when it is then [illegible] or other white [illegible] black and white dogs are playing together in the dusk the black dog can be distinctly seen when the white [illegible] same distance [illegible] WM. [illegible]

[illegible] Inverness, July 8

## [illegible] Foul Water

[illegible] brief stay at [illegible] I had frequent opportunities [illegible] mentioned by Mr. [illegible] at Sheerness [illegible] procuring a supply of water [illegible] then existed in very large [illegible] filtering the water before drinking [illegible] expected to find it so foul [illegible] agreeably disappointed [illegible] the bottom of the jar [illegible] animals I subjected a few [illegible] but being busy with other work [illegible] in Mr. [illegible] description. [illegible]

## Earthquake Proof Buildings

[illegible] memory plays [illegible] against earthquake [illegible] Japan [illegible] about twenty [illegible] WM. [illegible] of Edinburgh [illegible] Institution, [illegible]

## [illegible] QUESTION OF [illegible] AND ASTRONOMICAL [illegible]

[illegible] points made at the Washington Congress [illegible] that if Universal Time [illegible] Time would be [illegible] adopted, astronomical time [illegible] astronomers accepting the new [illegible] commencing at midnight [illegible] Congress the question naturally [illegible]

[illegible] well considered, and we think it desirable that we should now refer to some of the most important opinions which have already been given, not only as regards the desirability of the change, but as to the time at which that change should be brought about.

Among the first to accept the resolution was the Astronomer Royal, for the [illegible] use of the Observatory of Greenwich. Many opinions were collected at an early date and forwarded by Mr. Chandler, the Secretary of the U.S. Navy to the Senate. The [illegible] grew out of an order of Commodore Franklin, the Superintendent of the U.S. Naval Observatory, to adopt the new time on January [illegible] 1885. This was communicated to Prof. Newcomb, the Superintendent of the *American Nautical Almanac*, and drew a reply from Prof. Newcomb, from which we make the following extract:—

"If the Conference expresses [illegible] may be [illegible] arranged [illegible] at midnight [illegible]

[illegible]

"The first of these recommendations [illegible] change in [illegible] which [illegible] from [illegible] antiquity [illegible] of taking [illegible] the moment from which [illegible] Ptolemy. [illegible] of the [illegible] solely upon the [illegible] of changing the day at midnight, [illegible] was the most natural method of [illegible] time. At any one place [illegible] time is measured by [illegible] hour angle. [illegible]

[illegible]

[illegible]

… The indications of the times … will be altered by half a day. … inadvertently forgetting the … a day in error.

… Wherever this quantity … would, on the new system, … mean midnight …

… would remain unaltered except … which would be changed by …

… in the planetary … giving the predictions of …

… the gist of Commodore Franklin's … to Prof. Newcomb's objections: —

[illegible]

… Commodore Franklin's circular … as follows: —

… McCormick Observatory: —

… January 1, 1885.

[illegible]

… for internal use, and any … should state precisely what …

Prof. … Harvard College: —

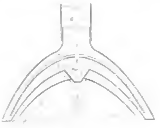
… important than the mode of …

…RINGTON, Ann Arbor—
…Washburn Observatory—
…1890.
…SON, Princeton—
…uary 1, 1885.
…, Warner Observatory—
…uary 1, 1885.
…LEY, Allegheny—
…uary 1, 1885.
…ER, Cincinnati—
…uary 1, 1885.
…, Washington University Observatory.
…ear at least for general …
…, Clinton.—We extract his letter:—

[illegible]

the purposes required; and that the first cost and the maintenance of the plant employed should be very moderate. In public estimation, simplicity is the first desideratum; and hence a simple and direct form of illumination has always been preferred to a more complicated arrangement, even when the latter has been found more economical as regards first cost and maintenance, and more brilliant in its effects. At the present time, however, in addition to these requirements, a purer atmosphere and a more pleasant temperature in our apartments are desired, which matters received very little or no attention in former days, when people were content with a simple dim light, and took little interest in sanitary matters. The regenerative gas-burner may be regarded as a combined lighting and ventilating apparatus, by the employment of which the close oppressive atmosphere, so unpleasant at large gatherings, may be entirely avoided. In fact, it is the outcome of the demand for cooler and purer air in our apartments, combined with light of high intensity.

The lamp has been designed with a view to protect the eyesight from the direct action of the source of light, without diminishing its power; its construction will be understood from the following description:—Four hoods, 1, 2, 3, 4, of sheet iron or other suitable material, are arranged within one another in such a manner that the products of combustion travel downward between



2 and 3, and upward between 3 and 4, while the air to be heated for feeding the flame passes upward between 1 and 2. On the uppermost hood, 4, a chimney, 6, is provided, while the hood, 3, is short[illegible] so as to allow a free passage for the products of combustion from the space between 2 and 3, to that between 3 and 4, and thus to the chimney. The hood, 2, [illegible] 5, through which the products of combustion pass away as described [illegible], through the passage between the three upper hoods, into the chimney. The lowest or innermost hood, 1, is open, so that the air may pass upwards between the hoods 1 and 2, as indicated by the arrows, to fill the inner space of the hood with heated air. The inner surface of this hood acts as a reflector, and in its focus are placed one or more fishtail burners of the usual type. As soon as the hood, 2, becomes sufficiently heated, through the action of the products of combustion passing between it and 3, the air between 1 and 2 will become heated, and, diminishing in its specific gravity, will automatically rise and fill the upper portion of the zone inside the hood, 1. By this arrangement the gas-jets burn within an atmosphere of heated air, with which they are consequently permanently supplied; the temperature of the air increasing with that of the gas-flames, and the brilliancy of the light increasing in the same ratio. The action is perfectly automatic, for, as the products of combustion pass away through the chimney 6, fresh heated air comes in at the same rate into the inner space of the hood 1 containing the gas-flames, to occupy the space which would otherwise be filled with cold air from the atmosphere below. The hot air which is supplied from the column of heated air formed between the hoods 1 and 2 will, on account of its *lower specific gravity*, always fill the upper space inside the hood 1, thus preventing the cold air of the atmosphere, which is at least three times as heavy, from rising inside the hood, 1, above a certain level, even in case of a disturbance in the atmosphere of the room. Thus no glass partition to exclude the cold air is required. The flame reflects its light directly downwards, as also from the inner surface of the hood, there being consequently an entire absence of shadows.

The light can be more or less concentrated or diffused, as desired, by varying the shape of the hood or reflector used. In some cases, where it is required to diffuse the light widely, or to diminish the downward radiation of heat, a bell-shaped glass, with its apex upwards, and its surface curving parabolically in the downward direction, may be employed, so as to cause all the rays of light it receives either to be refracted or to be reflected horizontally. If it is only desired to reduce the intensity of the downward radiation of heat, clear glass should be employed; if, however, it is also desired to diffuse the light, opaque glass is requisite, and the light may be thus more or less diffused, as may be required. The glass bell is suspended on a wire net of large mesh attached to a metal ring below, upon which and upon the netting the glass rests, so that, in case of accident, the broken glass would not fall below. It allows of free access to the flame, and does not form an integral part of the apparatus, so that its employment will not cause any particular trouble or inconvenience. As the intensity of the light depends entirely upon the [illegible] of heated air, the hoods may have any shape most suitable for the reflecting and for the purpose of [illegible] the light, provided that the height of the column of hot air between the hoods 1 and 2 be not relatively diminished.

The following tests of this lamp have been made:—The burners [illegible] removed from the dome were tested with the rays horizontal. The consumption of gas was 20 cubic feet per hour, and the illuminating power 57·5 candles, or [illegible] candles per cubic foot. They were then placed at an elevation of 1 foot 6 inches perpendicularly over a plain glass [illegible] placed at an angle of 45°, and in a line with the disk of the photometer. The distance from the standard light to the glass reflector was 18 feet 6 inches, which, added to the 1 foot 6 inches that the burners were placed above the reflector, made together 20 feet, the distance at which the light to be tested has to be fixed from the standard light in the photometer employed. In this case the consumption was again 20 cubic feet per hour, and the illuminating power was found to be 55 candles, or [illegible] candles per cubic foot, so that it would appear that there is an absorption by the glass in reflection of [illegible] per cent. The burners having been fixed in the dome reflector, the lamp thus arranged, was tested again as in the last experiment. The consumption of gas was [illegible] cubic feet per hour and the illuminating power [illegible] candles, or an average of 3·09 candles per cubic foot, [illegible] candles per cubic foot if the 4·35 per cent. found to be absorbed in the glass are added. The difference between [illegible] and 3·180 candles, or 0·305 candles per cubic foot gives the increase of light due to the use of the reflecting dome. After burning for some time the lamp was again tested, the consumption of gas was found to be reduced to 15·3 cubic feet per hour, and the illuminating power to be increased to 115 candles, being an average of 7·52 candles per cubic foot, or, allowing for loss by absorption, 7·84 candles per cubic foot. The difference between this and 3·180 candles, [illegible] 4·560 candles, gives the gain in light per cubic foot [illegible] as due to the regenerative arrangement, the [illegible] within a highly-heated atmosphere.

| Date | Particulars of Burner | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|
| [illegible] | Gas jets taken out of lamp [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | Same jets raised [illegible] reflect light [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | Same jets burning in [illegible] lamp | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | Same jets burning [illegible] lamp | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

Of course light may be diffused or transmitted [illegible] ctly by other means than those described, though [illegible] haps in a more simple or economical way. The [illegible] light has been to a certain extent already treated [illegible] lar way by suspending arc lights at great [illegible] by means of reflectors concentrating the light [illegible] certain areas. The intention has been [illegible] to illuminate whole towns [illegible] sources of light. [illegible] the concentration of the light [illegible] way from what [illegible] by the employment of [illegible] the loss of light [illegible] have been produced will be avoided. [illegible] at what height the light is placed [illegible] what area has to be illuminated [illegible] lector suitable for the [illegible] upon.

[illegible] conclusion, it must be [illegible] above downwards [illegible] of distributing light [illegible] one light only, the sky [illegible] the most perfect distribution [illegible] possesses, indeed, a [illegible] ere and clouds; and [illegible] ate Nature's reflector [illegible] ect means and [illegible] individual case.

## THE VOYAGE OF THE "CHALLENGER"

II

[illegible] plan adopted [illegible] reader a good [illegible] te of the researches [illegible] these researches [illegible] tailed studies of the [illegible] ns were afterwards [illegible] We are led [illegible] to biologic[illegible] temperatures [illegible] and suddenness [illegible] general impression [illegible] the skill and [illegible] man, of the [illegible] was done, and of the [illegible] obtained, is [illegible] ability which the [illegible] in giving [illegible] anything like a complete [illegible] voyage [illegible]

of the great deep. The reader must resign himself to be carried along as the naturalists of the expedition themselves were, and to listen to their story of what they saw and found.

In our notice of last week we left the *Challenger* at the Cape of Good Hope. From that station she strikes out boldly into the Southern Ocean, giving us glimpses of the Prince Edward and Marion Islands, with their proofs of recent volcanic action, the Crozet Islands and Kerguelen. In this part of the voyage the trawlings are extraordin-

[illegible]

[illegible] groups, [illegible] species [illegible] the more in-[illegible] the mention of [illegible] Carpenter and [illegible] the additions to our [illegible] by the expedition [illegible] around the geologist of the familiar Liassic *Extracrinus*, and give a singularly antique aspect to the fauna. Not less interesting is the living *Rhizocrinus*, which is a dwarfed and degraded descendant of the well-known chalk fossil *Bourgeticrinus*, as this in turn appears to have been a dwarfed representative of the Pear-encrinites of the Jurassic rocks. The genus *Bathycrinus*, previously known only from a single immature specimen, is now shown to have a wide extension in the Atlantic, but is not known in the fossil state. While the stalked crinoids have been dying out, the Comatulæ, or Feather-Stars, are probably more abundant now than at any former geological period, no fewer than four hundred species being now known, and three of the six genera into which they are referable having been discovered by the *Challenger*. In connection with the subject of recent crinoids some interesting observations are given regarding the Myzostomid parasites that infest these creatures and produce singular mal-formations. The resemblance of these distortions to those found upon many fossil Palæozoic crinoids no doubt indicates the presence of similar parasites even in the waters of the Palæozoic oceans. From the rich trawlings below water we are led by the narrative to the abundant bird-life of the Southern Ocean and to the conclusions regarding the structure and affinities of the Petrels reached by that able and lamented naturalist, the late Mr. W. A. Forbes.

From the pages of the narrative a good notion of Kerguelen with its snowfields and lavas, and Heard Island with its ice-cliffs and glaciers can be obtained. The profusion of life in these southern waters is not a little remarkable—sponges, alcyonarians, holothurians, ophiurids, asterids, echinids, annelids, amphipods, polyzoa, gasteropods, cephalopods, and many other invertebrates. But the *Challenger* now pushes southward to the Antarctic ice-cliffs, and as these seas are but little known, full details of this part of the navigation are given, with the soundings, dredgings, trawlings, and temperature observations taken along the route. Numerous woodcuts, phototypes, and chromolithographs of icebergs observed in the Antarctic Ocean are inserted, and a special chapter is devoted to the history of exploration in these seas, and to an account of observations made by the scientific staff of

FIG. 5.—New Volcano, Camiguin Island.

the *Challenger* on Antarctic temperatures, the density of sea-water, the true composition of sea-water ice, Antarctic icebergs, the deposits formed on the sea-bottom in the icy tracts of the Southern Ocean, the surface organisms of these seas, and a detailed summary regarding the hexactinellid and tetractinellid sponges collected.

Escaping from the perils of the ice-fields and Antarctic gales the vessel bears away to Australia, touching at Melbourne and Sydney and then, passing between the North and South Islands of New Zealand and northwards to the Fiji Islands, turns westwards again, through the Coral, Celebes and China Seas to Hong Kong. The account of this portion of the voyage is enriched with descriptions of numerous groups of animals collected during the expedition, particularly macrurous and brachyurous crustaceans, butterflies and moths, medusæ, star-fishes, amphipods, lamellibranchs, annelides, calcareous and horny sponges. The next track, from Hong Kong by Manila, Zebu, and the Admiralty Islands to Japan, takes up nearly 100 pages of the narrative. Among the more interesting observations recorded are those relating to the volcano of Camiguin Island, which burst forth upon a low plain in the summer of the year 1871 and in four years and a half rose to 1,950 feet in height, with abundant discharge of steam and with glowing lava at its summit (Fig. 5). The mountain is a dome-shaped mass rising from the seashore. It consists of various andesitic lavas but seems to possess no crater, resembling in this respect some of the trachytic domes of Auvergne. The lava is described as having apparently "issued from a central cavity and boiled over, as it were, till it set into the form of the dome." Probably the volcano is an example of the extravasation of viscous lava in successive shells, of which the outer are pushed outwards and upwards by the arrival of fresh material from below, as illustrated experimentally by Reyer. Mr. Busk supplies a *résumé* of his Report on the Polyzoa of the expedition. Professor E. Perceval Wright gives one on the Alcyonaria; Dr. Rudolph Bergh, one on the Nudibranchs; Professor Turner, one on the crania of the Admiralty and other Pacific Islanders; Professor G. O. Sars, one on the Schizopods and other crustaceans.

From Japan we are transported to the centre of the Pacific Ocean, and learn much by the way regarding the distribution of temperature in this vast expanse of water. A series of soundings taken from lat. 40° N. to lat. 40° S. affords a section of the very centre of the ocean through the volcanic peaks of Hawai and Tahiti. Perhaps no single part of the sounding work of the expedition offers a more impressive example than this of the boldness and success with which the problems of the deep sea can now be attacked. Down the middle of the widest and deepest ocean on the face of the globe a line of temperature soundings is taken with as much precision as if it had been an inland lake, and information is obtained that furnishes a clear picture of the depth of the water, the form of the bottom, and the manner in which the layers of different temperatures are superposed upon each other from the surface downwards. A careful survey of the coral-reef of Tahiti by Lieutenant Swire and Mr. Murray suggested to the latter observer the view which he has already published—that this reef and coral-reefs in general may be formed by the outward growth of the living coral upon a *talus* of coral-rock broken off by the waves, and do not prove subsidence as was believed by Darwin. Among the corals, briefly described by Mr. Moseley, probably the most beautiful of the madrepores is the delicately fragile *Leptopenus* trawled from a depth of 2,160 fathoms between Juan Fernandez and Valparaiso (Fig. 6). Prof. Hubrecht of Utrecht supplies some notes on the *Nemertea* in anticipation of his detailed Report on this subject. A summary is given of Mr. H. B. Brady's studies of the *Foraminifera*, which are so abundant in the surface waters and play so important a part in the formation of deep-sea deposits; and a digest of the Report of Dr. G. S. Brady on the copepod and ostracod crustaceans. But perhaps the most generally interesting section of this part of the narrative is that which treats of the nature of the organic deposits now forming on the floor of the deeper parts of the ocean. The important results obtained by the *Challenger* expedition in this novel department of enquiry have already been made familiar

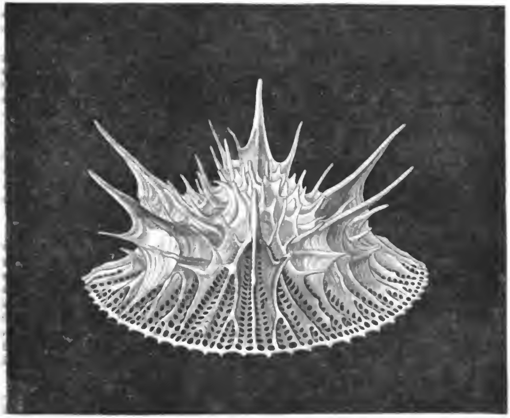


FIG. 6.—*Leptopenus hypocœlus*, Moseley.

by the writings of Messrs. Murray and Renard. But the reader will be glad to have them re-stated in the official account of the voyage, and to find them so admirably illustrated with woodcuts and a lithographic plate, which enable him to realise exactly the nature of the evidence for the extreme slowness of deposition at these great depths and so far from land. From no fewer than 116 sharks' teeth brought up with over two bushels of manganese nodules in a single haul from a depth of 2,385 fathoms, Fig. 7 has been selected for illustration. It differs in no essential particular from the tooth of *Carcharodon megalodon*, so common in Tertiary strata, except that it shows no large base.

Quitting Valparaiso, the *Challenger* pursues a southerly track to Port Otway, and then winding through the long line of sounds between the islands and the mainland passes through Magellan Strait to the Falkland Islands, and thence to Monte Video. During this part of the narrative we learn from Dr. Hoek what he has found out regarding the Cirripedes and Pycnogonids obtained during the cruise; from Mr. F. E. Beddard regarding the Isopods; from Mr. R. B. Watson about the Scaphopods and Gasteropods; from Mr. J. R. Henderson about the Anomurous Crustaceans; from Dr. Günther respecting the deep-sea fishes; and from Prof. E. Selenka regarding the *Gephyrea*. The course is then shaped eastward from Monte Video, across the South Atlantic to Ascension, and during the account of this *traverse* we are shown how the foraminiferal deposits of the deep sea were collected and investigated, and are supplied with a useful summary of the results arrived at by Messrs. Murray and Renard regarding deep-sea deposits in general, illustrated with an excellent coloured plate, which, in default of the actual objects themselves, brings their characters very clearly before the eye. As the narrative proceeds with the account of the homeward voyage from Ascension, we are told about pelagic diatoms, marine infusoria, coccospheres, rhabdospheres, bathybius, and the land-plants collected during the whole of the cruise, till at last the voyage ends at Spithead, on May 24, 1876. From the start on December 7th, 1872, till that date the vessel had traversed 68,890 nautical miles, and at intervals as nearly uniform as possible had established 362 observing stations.

The final chapter gives a summary of the results obtained by the officers of the Expedition, and by experts subsequently employed in the investigation of the density of sea-water, the composition of the salts of the ocean, the geographical and bathymetrical distribution of specific gravity, the carbonic acid, nitrogen, and oxygen present in sea-water, and a discussion of meteorological observations in their bearing upon oceanic circulation.

In this notice we have endeavoured merely to convey to the general reader some notion of the contents of the two portly volumes which contain the official narrative of the most important scientific expedition which has ever

Fig. 7.—[illegible]

been despatched by any Government for the investigation of the depths of the ocean. The materials are not yet ready for a complete digest of the whole work achieved. But it would have been an important addition to the value of the Narrative had the authors endeavoured to give such a digest as far as the materials are now in their hands, marking those portions regarding which the final reports had not been received. Such a summary, carefully arranged in subjects and with precise references to the detailed Reports for fuller information, would have been of great service to those who cannot follow all the technical details of the Reports, as well as to the specialists who wish to learn to what source they have to turn for their own requirements. Let us hope that in a future edition of the narrative this want will be supplied. Meanwhile no one can rise from the perusal of these volumes without an admiration for the solid, painstaking, and conscientious way in which their compilation has been accomplished. They are not light reading, but they abound in material of general interest and form a fitting record of the great Expedition which they chronicle.

## NOTES

The fourteenth meeting of the French Association will take place on August 12 at Grenoble. M. Verneuil, Member of the Academy of Medicine, will be President. The public lectures will be "On the New Gallery of Palaeontology of the Paris Museum," by M. Cotteau, ex-chairman of the Geological Society of France, and by M. Rochard, General Inspector of the Marine, on "The Victualling of France." A large number of medical questions will be dealt with in the several sections of the Congress. The Ferran cholera experiments are sure to be discussed at full length. Numerous excursions will take place in the Alps under competent guidance as far as Chambery.

In the course of the present summer the *Geological Magazine* will be twenty-one years old. During that period Dr. H. Woodward has been one of its editors, and for almost the whole time the principal editor, on whom the burden of the work has fallen. Further, the arrangement made with the publishers, in order to secure the continuance of the *Magazine*, would have actually resulted in pecuniary loss, but for illustrations presented by authors. Of the ability with which the *Magazine* has been conducted, and of its value to geologists, there can be no question. A committee has been formed, with Prof. Bonney as chairman, to give expression to their sense of the services which he has rendered to geology by presenting him with a testimonial, of which a piece of plate will, at any rate, form a part. The secretary and treasurer of the committee is Mr. G. J. Hinde, 11, Glebe Villas, Mitcham, Surrey, to whom subscriptions may be paid, or to the "Woodward Testimonial Fund," at the London and Westminster Bank, Limited.

Elaborate preparations have been made in the neighbourhood of Niagara Falls for the formal transfer to-day to the Government of New York State of the strip of land adjoining the Falls on the American side. This strip will be thrown open for the future, free to the public, as "The Niagara International Park." [illegible] representing both New York State and Canada will attend the ceremonies. The transfer attracts much attention, as it renders America's great cataract free henceforth to the world. We have already alluded at some length to the [illegible] of the Falls and immediate neighbourhood by the State.

The annual meeting of the Royal Archaeological Institute will be held at Derby from Tuesday, July 28, to Wednesday, August 5, inclusive. The [illegible] of the [illegible] sections will be: Antiquarian, the Rev. [illegible] Cox, LL.D.; Historical, the Dean of Lichfield; Architectural, the Right Hon. A. J. Beresford Hope.

The [illegible] of the Ben Nevis Observatory have been received to the end of June. During the twelve months ending with June the rainfall has now been measured with all possible care except [illegible]. During the year the whole of the rainfall, [illegible], amounts to 152·15 inches. Averaging the monthly falls from June, 1884, the mean annual rainfall on the top of Ben Nevis is 145·71 inches, which is thus the largest mean annual rainfall of any place at which rain has been observed in Scotland. The largest rainfall in any single month was 25·30 inches in December, 1884, and the smallest 4·85 inches in April, 1885. Falls of an inch a day, or upwards, are of comparatively frequent occurrence, having been recorded during one day in seven out of the 365 days. On two of the days upwards of four inches of rain was measured at the Observatory.

A TELEGRAM from Cooktown to Berlin, July 8, announces the arrival there of the New Guinea Company's steamship ... with Dr. Finsch on board, who is returning to Europe from his recent exploring expedition along the unknown parts of the coast of Kaiser Wilhelm's Land (New Guinea), which are situated between Astrolabe Bay and Humboldt Bay. Dr. Finsch reports the discovery of several good harbours and a navigable river. The land is suitable both for agriculture and stock-raising. The natives were friendly.

THE Comptroller General of patents, designs, and trade-marks has issued, in the form of a Parliamentary paper, his report ... since the passing of the Act of 1883. That the new Act has worked well in the interest of inventors may be seen from the fact that the number of applications for patents, which ... with some variations, almost constantly in the ... years, from ... in the year 1852, to 6241 in 1883, leaped at a bound to 17,110 in 1884. The increase is, in fact, between the years 1883 and 1884, no less than 105 per cent. ...ty-nine per cent. of the applications were made by persons ... in the United Kingdom—namely, 12,356 being resident in England and Wales, 901 in Scotland, and 254 in Ireland. Of the rest the largest number were from the United States, 1181, from Germany 897, and from France 788. ... from twenty-seven other countries the ... applications ... thirteen such countries being British possessions. ... 175 applications were made, and three, it may be added, were made from Egypt. Only three appeals were made in the course of the year against the decision of the Comptroller ... may be taken that his decisions ... almost invariably ... to applicants. The receipts ... [illegible] ... *l.*, of which 88,900*l.* were for patent fees, 3477*l.* for ... fees and stamps, 7014*l.* for trade-marks fees ... and ... *l.* for the sale of publications. The ... [illegible] ... were 30,225*l.* for salaries ... [illegible] ... the report ... and 17,... to Messrs. Eyre and Spottiswoode for printing. There was a surplus ... [illegible]

... International Telegraph Congress ... [illegible] ... will be attended by delegates from all the ... and from Brazil ... [illegible] ... Cochin China, Japan ... New Zealand ... Colony, South Australia, and Victoria ... the great cable companies ... [illegible] ... will consist of various ... [illegible] ... ially a general reduction of ... [illegible]

... Council of University College, London, ... [illegible] ... ship of Electrical Engineering ... [illegible] ... Fleming thereto. Dr. Fleming ... [illegible] ... electrician with the Edison and Swan Electric Light ... [illegible]

... the following extract from Prof. ... [illegible] ... as to the proceedings ... [illegible] ... year ending May 31, 1885 ... [illegible] ... made with the ... [illegible] ... of right ascension and ... [illegible] ... include 658 ... [illegible] ... observations of Polaris ... [illegible] ... circle readings ... [illegible] ... 180 circle ... [illegible] ... Wells's Comet, and ... [illegible] ... 100 nights, the greater ... [illegible] ... without ... [illegible] ... tal adjustment ... [illegible] ... vel 203 times ... [illegible] ... of observation ... [illegible]

... from June 18 to 23, 1884 ... for the ... coefficient ... 0·851; this will need confirmation, as it differs considerably from the former determination, 0·826. ... of clock stars and those of Polaris are completely reduced, and the mean places for January 1 obtained up to the end of 1884. The true apparent places of all the other stars observed in 1884 ... also obtained both in Right Ascension and North Polar Distance. As regards the observations of former years.—The mean R.A. and N.P.D. of the Zone Stars are deduced up to December 12, 1879, and the ... apparent R.A. and N.P.D. to the end of 1882, and the ... for ... 1882. The reductions from mean ... apparent ... of ... to the end of 1882. The ... readings are deduced up to the present time. The ... R.A. were used in the reductions for 1884 were ... from 63 observations of Polaris ... January ... to ... 1884 ... by taking the mean of ... Polaris ... the mean of the declinations, and ... [illegible] ... by deducing the ... from each individual observation, and taking the mean of the ... The ... two methods ... agreed. The meteorological observations are ... and daily ... to the Meteorological Office. ... employed, and the ... [illegible]

... PRJEVALSKY telegraphed to St. Petersburg from Kiria, in Khotan, on June 20, that during April and May he and his party had explored the region between Lob Nor and Kiria, and that, leaving ... in the latter place, he was about to go into the neighbouring Tibet ... whence he would return to Kiria ... and then ... back to Russia.

... [illegible] ... spectra of ... [illegible] ... the Royal Society ... [illegible]

... [illegible] ... Department of Agriculture ... [illegible]

[illegible] northern wing was gutted. The College was insured for 10,000*l.*, but the damage will amount to 40,000*l.*

A TELEGRAM from Simla, July 9, states that shocks of earthquake continue to be felt in Cashmere at intervals of two or three days. A severe shock occurred at Srinagar on the 4th inst.

[illegible]

[illegible]

…h Africa, presented by Mr. G. C. Barnet; an American … (*Taxidea americana* ♂) from North America, presented … F. J. Thompson; a Common Fox (*Canis vulpes*) … presented by Mr. Christopher Heseltine; a Rufous Rat … (*Hypsiprymnus rufescens* ♀) from New South Wales, … by Miss Laidlaw; a Red-throated Amazon … from Jamaica, presented by Mrs. S. Wai…; … …ted Guan (*Penelope cristata*) from Central America, … by Mr. G. H. Hawtayne, C.M.Z.S.; a Leopard … (*Testudo pardalis*) from South Africa, presented by … netta Hodges; two Crowned Horned Lizards (*Phrynosoma coronatum*) from North America, presented by Mr. … Napier; a Cinereous Vulture (*Vultur monachus*) … a Nonpareil Finch (*Cyanospiza ciris*) from North … deposited; an Axis Deer (*Cervus axis* ♂), … Mare… (… *macrotis* ♂), three Long-fronted Gerbilles (… *longifrons*), seven Mandarin Ducks (*Aix galericulata*), … Pintails (*Dafila spinicauda*), bred in the Gardens.

## …NOMICAL PHENOMENA FOR THE WEEK, 1885, JULY 19–25

…reckoning of time the civil day, commencing at … mean midnight, counting the hours on to 24 …

*At Greenwich on July 19*

…h. 7m.; souths, 12h. 6m. … sets 20h. … meridian, 20° 47′ N.; Sidereal Time at Sunset … m.

… First Quarter) rises, 13h. 10m.; souths, 18h. … … 58m.; decl. on meridian, 10° 33′ S.

[illegible]

*Phenomena of Jupiter's Satellites*

[illegible]

## …ING UNIVERSITY FOR LONDON

…nary meeting of the Convocation … will be held in the … Committee appointed … a Teaching University for London … Justice Fry, who will …

…port of the Special Committee … be received and … …nate be requested … to take such steps as they … …el.

…mmittee of this House … …d to confer with the Senate … …e the Senate shall … …the scheme for the … …he Special Committee … …ity to consist of: (1) Senate; (2) … …ent Colleges; (4) Faculties; (5) … Queen as Visitor.

…

2. … consist of the Chancellor and … Vice-Chancellor … to be … Chan… …cellor of … and not more than thirty … ordinary members, including the Vice-Chancellor, of whom six shall be nominated by the Crown, six shall be elected by Convocation, and … shall be elected by each of the four Faculties. … shall become … the President … shall be nominated by the … College, London, one shall be nominated by the President of the Royal College of Physicians of London, one shall be nominated by the President of the Royal College of Surgeons of England, … by the Chairman of … Legal … one shall be nominated by …

3. The … themselves on …

4. … members of the Senate … those who … in office for … by ballot.

5. …

6. Power to …

7. …

8. In the … [illegible]

19. The Institutions from which the University receives certificates for degrees in Medicine (hereinafter called the recognised Medical Institutions) to retain their right of giving such certificates whether they be or be not constituent colleges.

20. The list of recognised medical institutions to be subject to the existing power of revision, but so that the Senate shall not report thereon without the previous advice of the Faculty of Medicine (see Charter of January 6, 1863, section 37).

IV.—FACULTIES

21. There shall be four faculties—viz. (1) Arts; (2) Laws; (3) Science; (4) Medicine.

22. All departments of knowledge in which examinations may be held by the University, and not included in any of the other faculties, shall be included in the Faculty of Arts.

23. Each faculty shall consist [illegible] of the representatives of the constituent colleges, [illegible] the examiners in the faculty during their periods of office and three years afterwards, [illegible] such persons eminent in the studies with which the faculty is concerned, not exceeding six in number, as the faculty may elect, and for such periods as they may determine.

24. Each faculty shall [illegible] for three years [illegible] three members of the Senate [illegible] members of a board of studies.

25. The [illegible] to be elected under the last clause may be members of the faculty not being examiners in office, and on ceasing to be members of the faculty or accepting the office of examiner such persons will [illegible] their [illegible] member of the Senate or board.

26. On any matter connected with [illegible] faculty may [illegible] make recommendations to the board of studies in all matters within the competence of the board, [illegible] the Senate.

V.—BOARDS OF STUDIES

27. There shall be a board of studies in each faculty.

28. Each board shall consist of [illegible] number of members being a multiple of three, and not less than seven nor more than twenty-one, as the faculty shall from time to time determine, together with one member of Convocation to be elected by Convocation.

29. One third of the faculty members shall retire each year.

30. The member elected by Convocation [illegible] for three years.

31. Power to fill up [illegible]

32. Power to re-elect.

33. Each board shall elect a chairman [illegible]

34. Each board of studies shall have the following [illegible] duties:— [illegible]

[illegible]

35. Boards of studies may [illegible] they or any of them shall from time to time think it desirable [illegible] a particular subject.

VI.—EXAMINERS

36. The examiners in each faculty may from time to time make such reports and recommendations to the faculty or the board of studies as they may think fit.

VII.—DEGREES

37. Candidates to be admitted to matriculation and all degrees other than degrees in the Medical Faculty without regard to the place of their education.

38. Candidates for degrees in the Faculty of Medicine to show that they have passed the required course of instruction in a constituent college in the Medical Faculty or in a recognised medical institution.

VIII.—GENERAL PROVISION

39. Except so far as altered by the foregoing provisions either directly or indirectly, the existing constitution of the University to be retained.

## DANISH RESEARCHES IN GREENLAND

DURING the last few years the Danish Government have despatched several scientific expeditions to her great but sparsely populated dependency, Greenland, for the purpose of exploring it geographically, zoologically, botanically, and mineralogically, while efforts have also been made to learn something of the Norse archæological remains in South Greenland. Glacial researches, too, have been prosecuted and valuable observations made of the enormous ice field—the inland ice, which fills the entire interior—and of its movements to the sea through the numerous fjords, the birthplace of the greatest icebergs in the northern hemisphere.

The results of these varied researches have only been published after a long delay. It should, however, be stated that the Danish Government have followed a carefully prepared plan on this point, as the Royal Commission appointed for the purpose [illegible], consisting of Prof. Johnstrup, Admiral Irminger, and Dr. Rink, have decided that the results of the researches should not be made public until their analysis was completed in every detail. These have been embodied in the work published by the Commission, "Videnskabelige Meddelelser om Grønland" (Scientific Informations about Greenland), a publication which has [illegible] one of the gold medals of the French Academy, and of which six or seven volumes have been published. In addition to this work we have received [illegible] 100 [illegible], with facsimiles [illegible] found in North Greenland, described and [illegible] the late Prof. Oswald Heer, of Zurich, who also [illegible] Mr. E. Whymper, in 1867, brought [illegible] the peninsula of Noursoak, an [illegible] was published in the *Transactions* of the [illegible] 445–488, with eighteen lithographed [illegible]

[illegible] Danish expeditions were at work along the [illegible] shore.

The first of these, under [illegible] Jensen, known for his [illegible] on the inland ice, was engaged in exploring and [illegible] on the west coast between [illegible] and Holstensborg [illegible] 67° N. lat., where there is a network of [illegible] fjords, [illegible] mountains rising from 6000 to 7000 feet [illegible] 100 miles into the [illegible]

[illegible]

[illegible] J. Holm, is in its second [illegible] from Cape Farewell, along the [illegible] by pack-ice. [illegible] the exploration of [illegible] 70° lat. N., where the former [illegible]

[illegible] as far north as [illegible] the members, viz. Lieut. Garde [illegible] station at Nanortalik (lat. [illegible] meteorological [illegible] being a continuation of [illegible] 1882–83 [illegible] Observations of ice [illegible] The two [illegible] who have wintered [illegible] according to latest [illegible] where a depot has been [illegible] at the end of July last year, northwards, in the [illegible] eighty [illegible] of whom lived on the east [illegible] way home from trading on the south [illegible] There were [illegible] boats in all. Late in July the great glacier [illegible], which reaches down to the sea, and which in 1830 [illegible] the only European who had hitherto [illegible] was passed without much difficulty. Soon after Tingmiarmiut [illegible] 62° N. lat. was reached, the northernmost place whence we have heard of the party. It was their intention to attempt to reach a place, [illegible] in lat. 65° N. before the winter, where there [illegible] settlement of Greenlanders, but which has never been [illegible] Europeans. It lies near the place where Nordenskiöld [illegible] in 1883 without seeing any natives. In the spring of the [illegible] year the coast will be explored, but we shall have no [illegible] of the party until they return home. [illegible] the east Greenlanders were very kind and friendly. They [illegible] all heathens. They were particularly remarkable for their [illegible], being tall people, generally with dark eyes and hair, without any trace of the Eskimo. However, that they [illegible] be descendants of Norsemen seems highly [illegible] of their uncivilisation and want of religion, [illegible], and traditions. The party at [illegible] great fjords, between lat. 62° and 6[illegible] N., [illegible] without finding the least trace of Norse ruins.

[illegible] expedition may be expected to return at the end of 1885; [illegible] is, however, great probability of the party [illegible] having to spend another year on these [illegible] the European, in order to exist, has to [illegible] like the Eskimo. [illegible] the above mentioned two expeditions were [illegible] explorations, the third [illegible] unbroken field for research, viz. [illegible]

Between 1876 and 1879 [illegible] the sea between Iceland and Greenland [illegible] by the French Admiralty [illegible] and Baffin's Bay [illegible] only [illegible] by H.M.S. [illegible] on the return [illegible] in 1875 [illegible] Sir George Nares [illegible] Expedition, 1882 [illegible]

[illegible]

The [illegible] were made, in sounding, trawling, and [illegible] on the extensive banks which, between 6[illegible] and [illegible] N. [illegible] everywhere [illegible] the shores of Greenland with [illegible] channel between them and the coast, and in the Davis Strait.

The [illegible] did not extend to very [illegible] depths, the greatest [illegible] being only about [illegible] fathoms south-west of [illegible], while on the [illegible] connecting Greenland with Cape Walsing[illegible] the place where Davis Strait is narrowest [illegible] about [illegible] 67° N. [illegible] of [illegible] fathoms only were struck. In the [illegible] Bay, where no sounding had previously been taken, a [illegible] varying from [illegible] 250 fathoms was found, and it has [illegible] by the [illegible] Expedition that at the mouth, at [illegible] of [illegible] fathoms, a barrier separates this basin from Davis Strait, and thus [illegible] icebergs of a greater draught from passing from the great fjord of Jacobshavn into the [illegible]. Judging by the results of the measurements of ice[illegible] during [illegible] in this fjord by Prof. Steenstrup [illegible] for the purpose of ascertaining the [illegible] between the part above and the part below the surface [illegible] it has been found that only icebergs with an [illegible] of 150 feet [illegible]

[illegible]

to 2°8, and [illegible] from 30 to 100 fathoms [illegible] 0°2 C. That the icebergs in these waters must melt rapidly, particularly at the water line, is clear, which was the [illegible] by experience, all being deeply furrowed and heeling over.

The trawlings and [illegible] extended to a depth of 300 fathoms, and were effected as well in Davis Strait, Baffin Bay, on the banks, as in the fjords. The result was considerable, and several varieties of fauna previously unknown in the Greenland seas were caught, as well as some entirely new species. Among the rarest [illegible] may be mentioned [illegible] [illegible], [illegible], which are only known in a few species from the west coast of Norway, and [illegible].

The harvest was richest on the banks [illegible] the case under previous expeditions, and poorest in Disco Bay, where several hauls at a depth of 200 to 250 fathoms brought up absolutely nothing, or only a couple of specimens of the same species. The trawl worked here only down in the soft black clay, which everywhere covers the bottom, [illegible] the [illegible] constantly the [illegible] to [illegible]. The expedition has brought home a [illegible] of 350 specimens of the deep-sea fauna.

During the stay in port the officers of the vessel were engaged in hydrographical labours, chiefly the measuring of certain harbours, and the botanists in excursions into the long, narrow fjords, where the vegetation [illegible], but neither the mountains nor the [illegible] were forgotten. The harvest was very rich. [illegible] higher cryptogams alone specimens of 230 varieties were [illegible], and five new plants were discovered, among which a new species of [illegible], while several were found in entirely new places, whereby their geographical distribution has been [illegible] with several degrees of latitude. [illegible], for the first time in 1885, discovered in Greenland, and [illegible] [illegible] [illegible]

[illegible]

[illegible] fjord in these [illegible] [illegible] [illegible] [illegible] [illegible] presented to the [illegible] Museum [illegible] [illegible] [illegible]

[illegible]

That the Danes are [illegible] the [illegible] of this great and difficult work [illegible] [illegible].

## THE ROYAL SOCIETY OF CANADA

THE fourth annual meeting was held in Ottawa on May 26 and following days [illegible], the President, T. Sterry Hunt, LL.D., F.R.S., in the chair. The following papers were read in Section III. (Mathematical, Physical, and Chemical):—On the analysis of silk, by Dr. H. A. Bayne, Royal Military College. The author selected samples of pure silk and linen and cotton (these purity being carefully determined beforehand by the [illegible] microscope), and after removing [illegible] matters, colouring matter, &c., by ether and dilute hydrochloric acid, submitted all four samples to the action of a large number of reagents in order to determine to what extent solvents of silk affect other fibres also. The result of a large number of analyses showed that, for mixtures of silk and wool, basic zinc chloride is the most reliable reagent, while for mixtures of silk and cotton or linen, Loewe's alkaline glycerine solution of oxide of copper gives the most trustworthy indications.—Mémoire sur [illegible] et l'interprétation rationnelle des quantités négatives et des quantités imaginaires dans le calcul, by Dr. [illegible].—[illegible] of natural silicates, by Dr. T. Sterry Hunt, F.R.S.—Blowpipe reactions on plaster tablets, by Prof. Haanel. This was in continuation of previous investigations.—Note on the quantitative blowpipe assay of [illegible], by Prof. Haanel.—On the determination in terms of a definite integral of the value of the expression—

$$[illegible]$$

[illegible] quantity raised to [illegible] integer, and [illegible] numerically less than [illegible] approximate values in [illegible], M.A. In this paper, after [illegible] M. Cauchy [illegible] [illegible]

[illegible]

[illegible] M.A. [illegible] Prof. [illegible] Longitude [illegible] Montreal, and [illegible] Prof. [illegible] [illegible] determination of the [illegible] Toronto, and Cobourg, by [illegible] M.A., [illegible] and Chandler, M.A.—[illegible] of a [illegible] of energy in [illegible] by Prof. [illegible]. [illegible] New Brunswick, [illegible] province, by Prof. [illegible] localities, [illegible] Rev. Dr. [illegible]. A study [illegible] was made [illegible] which were considered to [illegible] from the county of [illegible].—A [illegible] with notes on the distribution [illegible] explained merely in a few remarks, [illegible].

The following papers were read in Section IV. (Geological and Biological):—On the [illegible] of the Rocky Mountain region of Canada, by Sir W. Dawson.—Fossil plants from the Trias and Permian of Prince Edward Island, by Sir W. Dawson.—[illegible] of the fauna of the St. John group (third part), by G. F. Matthew. This paper was in continuation of former communications. It describes a large number of Cambrian forms, particularly trilobites, and discusses the relations of the subdivisions of the Cambrian of the vicinity of St.

For a long time these levels were installed beneath cases on a column kindly lent to me by the Professor of Natural Philosophy in the Imperial College of Engineering. Here they remained for over a year, after which they made many journeys. At one time they were nearly 13,000 feet above sea-level on the top of the conical Fujisan. At another time they were some hundreds of feet below sea-level at the bottom of the Takashima mine. These observations attracted the attention of the authorities at the Imperial Observatory, who, recognising the bearing they might have upon work which was going on in the Observatory, they supplemented my observations with a second set of levels. All the usual precautions were taken to guard against the effects of temperature, and observations were carried out every three hours both day and night for more than a year. As the books of records accumulated, and the curves grew until some of them were 30 to 40 feet in length, experience showed that the errors chiefly due to changes in temperature might be equal to and even exceed the effects which were being sought. Now, I am inclined to an opinion communicated to me in a letter from M. d'Abbadie, who remarked that two levels upon the same column might be parallel, and yet their bubbles might move in

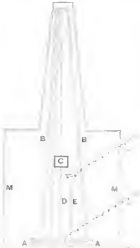



Fig 1

opposite directions. Notwithstanding this, the observations [illegible] levels have led to some interesting results.

First, there is the fact that level bubbles may wander without there necessarily being a change of level. Second, that level bubbles continue to move long after the sensible motion of an earthquake has ceased, thus giving us a means of observing the movements of long periods which usually bring the phenomenon of an earthquake to a close. After the earthquake the bubble will sometimes take up a position slightly different to that which it had before. Changes in the position of bubbles have been observed a short time before some of our earthquakes. Another result is the fact that the greatest irregularities in the curves showing the position of the bubbles of a level occur when earthquakes are most numerous. This is during the winter months. A last result is the fact that during a typhoon, or when the barometer is unusually low and fluctuating, a level bubble may be distinctly seen to pulsate through a small range, as if there were continuous changes of level going on.

While working with the levels another kind of instrument which I employed was a pendulum suspended from an iron stand, and so arranged that its style could be viewed in the field of a microscope. By placing a prism beneath the end of the style, the image of its end could be looked at horizontally, and the motion of the pendulum could be seen in any azimuth. At first I employed two microscopes placed at right angles, but by the adoption of the prism one microscope became sufficient. With these instruments, which are similar to those employed by Messrs. Bertelli, M. de Rossi, and other Italian observers, I verified for myself some of the more important results which had been noted in Europe.

For instance, it was seen that the pendulum was seldom at rest. Storms of tremors would take place with a low barometer. The pendulum did not always vibrate over the same point. It appeared as if there had been a tip in the soil, and the stand of the apparatus had been slightly inclined. These, together with other results which in many respects are little more than repetitions of results obtained by Bertelli, Rossi, and other observers, I have already published. Without attempting to describe other experiments which I have instituted, I will now give a brief description of an instrument which has been reached gradually, and which has given me the greatest satisfaction. From a letter received from M. d'Abbadie, whose researches regarding the change of vertical are amongst the most important yet instituted, I learn that my instrument has many points in common with one employed by M. Bouquet de la Grye. When I first set up this instrument, it was simply as a contrivance intended to make electrical contact, and set certain machines in action at the time of an earthquake. I next employed it as an instrument to record the occurrence of slight earthquakes. In its third form it was used to indicate earth-tremors and deviations in the vertical.

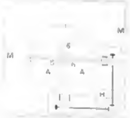



Fig 2

It will be readily understood from the accompanying sketches, Figs. 1 and 2. [illegible] is a circular disk of [illegible] about [illegible] inches in thickness, resting on levelling screws. Bolted to this is a tripod of angle iron about 5 feet high, B B. This forms the support for a pendulum, [illegible]. The bob of this pendulum weighs about 3 lbs. It is made of a brass tube 1½ in. diameter and 2½ in. long, filled with lead. This is carried by a thin iron wire 3 feet 4½ inches long, soldered into a small hole in a plate at the top of the tripod. A spike, [illegible], projects from the base of the bob (see Fig. 3). [illegible] the bob with its spike were turned in a lathe, the end of the spike, the point of support and the centre of [illegible] of the bob, lie [illegible] in a straight line.

A long, light pointer, [illegible] of bamboo, which has been [illegible] of the pointer, [illegible] Fig. 2. At the [illegible] of the pointer there is a light [illegible] two fine needle-points, [illegible] The [illegible] is kept in [illegible] with the base of the pendulum by turning the screw [illegible], which raises the [illegible] spring [illegible] It is carried by [illegible], which rests at three points on [illegible] is a [illegible] which is nearly equal in weight to that of the pointer [illegible].

In one instrument [illegible] which the total length of [illegible] is 485 mm. With these dimensions we may suppose that if the bob pendulum moves, say, [illegible], then the lower end of the pointer would move about 68 mm. The values to be given to the deflections observed in the pointer have also been estimated by giving a slight turn to one of the levelling screws of the base plate, and thus tipping the plate through a known angle.

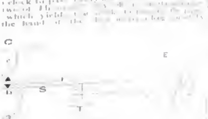
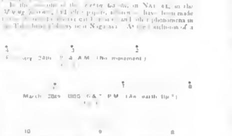



Fig. 3



February 24th ... A.M. (No movement.)

March 28th 1885 ... P.M. (An earth tip?)

March ... 1885 ... P.M. (Tremors & Earthquake.)

As to what may be the cause of earthtremors I am not prepared to offer a definite opinion; but, inasmuch as their association with barometric fluctuation renders it possible that in their occurrence they may also be associated with the escape of fire-damp, about which we have a little knowledge of practical value, it seems impossible that their study should be neglected.

Whether the results of such a study would be of practical value to the miner is not known, but that results of scientific value would be obtained [illegible].

As the making of such observations are neither a matter of trouble or serious expense, I [illegible] that they may be undertaken. [illegible] experiments which I made with [illegible] instruments in the [illegible] of [illegible], which [illegible] very marked and [illegible] character.

Tokio, Japan JOHN MILNE

## SOCIETIES AND ACADEMIES

### LONDON

**Royal Society**, June 18.—"The Removal of Micro-organisms from Water." By Percy F. Frankland, Ph.D., B.Sc., F.C.S., Associate of the Royal School of Mines.

The author has investigated the efficiency as regards the removal of micro-organisms, of methods of water purification depending upon:

(a) Filtration.
(b) Agitation with solid particles.
(c) Precipitation.

The method of investigation consisted in determining the number of organisms present in a given volume of the water before and after treatment, the determinations being made by Koch's process of gelatine culture on glass plates.

*Treatment of Water by Filtration.*—The filtering materials examined were greensand, silver sand, powdered glass, brickdust, coke, animal charcoal, and spongy iron. These materials were all used in the [illegible] state of [illegible], being made to pass through a sieve of 40 meshes to the inch, and in columns of 6 inches in depth. The following results were obtained:—

| | No. of organisms before filtration | No. of organisms after filtration |
|---|---|---|
| Greensand | 86 | [illegible] |
| ditto after 13 days | 8,163 | [illegible] |
| ditto after 1 month | 4,284 | [illegible] |
| Silver Sand | 11,732 | [illegible] |
| Powdered Glass | 11,732 | [illegible] |
| Brickdust | [illegible] | [illegible] |
| ditto after 4 weeks | 5,137 | [illegible] |
| Coke | 1,112 | [illegible] |
| ditto after 5 weeks | [illegible] | [illegible] |
| Animal Charcoal | [illegible] | [illegible] |
| ditto after 12 days | [illegible] | [illegible] |
| ditto after 1 month | 4,284 | [illegible] |
| Spongy Iron | [illegible] | [illegible] |
| ditto after 12 days | [illegible] | [illegible] |
| ditto after 1 month | 4,284 | 2 |

These greensand, coke, animal charcoal, and spongy iron were at first [illegible] in removing all organisms [illegible] passing through them, but [illegible] power was in every case [illegible] enlarged, however, as spongy iron [illegible] very [illegible], while the greensand and brickdust were [illegible], and the number of organisms in the water [illegible] through animal charcoal was greater than in the untreated water.

*Treatment of Water by Agitation with Solid Particles.*—Water was agitated with [illegible] of [illegible] particles, [illegible] and [illegible] the [illegible] the number of organisms in the water [illegible] was determined. [illegible] shaking with [illegible] of water. The agitation was [illegible] all cases [illegible] 15 minutes, [illegible] was [illegible] according to the length of time which it required for the water to become clear. The following results were obtained:—

| | No. of organisms in 1 c.c. of water before treatment | Ditto after treatment |
|---|---|---|
| Spongy Iron (1 minute agitation, ½ hour subsidence; 5 grms. used) | 600 | 28 |
| Spongy Iron (15 minutes' agitation, ½ hour subsidence; 5 grms. used) | 600 | 63 |
| Chalk (15 minutes' agitation, 5 hours' subsidence) | 8,325 | 274 |
| Animal Charcoal (15 minutes' agitation, 5 hours' subsidence) | 5,125 | 60 |
| Coke (15 minutes' agitation, 48 hours' subsidence) | Too numerous to be counted | 0 |
| Glass Clay (15 minutes' agitation, 5 days subsidence) | — | Too numerous to be counted |

In order to ascertain whether subsidence alone would diminish the number of organisms contained in the upper strata of water, [illegible] of water were allowed to remain [illegible] perfect rest, and then the upper layers in the several bottles were tested for organisms at different intervals of time. Thus:—

| Hours at rest | No. of organisms found in 1 c.c. of water |
|---|---|
| 0 | 1,073 |
| 6 | 6,028 |
| 24 | 7,262 |
| 48 | 48,100 |

Thus, without agitation with solid particles and subsequent subsidence of the latter, there is no diminution but, on the contrary, an increase in the number of organisms in the upper strata of water.

*Treatment of Water by Chemical Precipitation.*—The effect of [illegible] process in removing organisms from water was investigated both in the laboratory and on the large scale. In the laboratory experiments the following results were obtained:—

| | Organisms in 1 c.c. |
|---|---|
| [illegible] water | 85 |
| [illegible] 48 [illegible] | 1,022 |
| Water after Clark's process and 18 hours' subsidence | 42 |

In a second series of experiments the following results were obtained:—

| | Organisms in 1 c.c. |
|---|---|
| [illegible] | 37 |
| [illegible] 24 hours [illegible] | 42 |
| [illegible] 48 hours [illegible] | 298 |
| Water after Clark's process and 21 hours' subsidence | 22 |
| [illegible] 48 [illegible] | 166 |

On the large scale [illegible] of the process was examined at the [illegible] Valley Waterworks, Bushey:—

| | Organisms in 1 c.c. |
|---|---|
| Hard water | 322 |
| Water after [illegible] and 2 [illegible] subsidence | 4 |

A second [illegible] at the [illegible] Gaillet and Huet's [illegible]:—

| | Organisms in 1 c.c. |
|---|---|
| Hard water | 182 |
| Soft water | 4 |

[illegible] the number of organisms present [illegible] Clark's process [illegible] would be removed [illegible] rapidly [illegible] of time, as otherwise [illegible] through the water.

[illegible] *Water.*—The number of organisms [illegible] has been determined by the [illegible], [illegible] the results of a monthly examination, in [illegible] of the [illegible] waters supplied to London during the first three months of the present year:—

...al Society

Mineralogical Society

Academy of Sciences

M. Mascart's recent note on the great movements of the atmosphere, by M. Faye.—Researches on vegetation: on the carbonates in living plants, by MM. Berthelot and André. In this paper the authors explain the methods followed by them in determining the quantity of the simple organic salts now known to be largely, if not universally, diffused throughout the vegetable kingdom.—Anatomy and physiology of [illegible], a remarkable parasite found largely associated with certain [illegible], by M. de Lacaze Duthiers.—On the homography of [illegible], by M. Sylvester.—Report on the experiments made in Holland and Belgium on an application of the large movable tubes of the hydraulic system constructed at the [illegible] of the [illegible], further modifications of that system, by M. [illegible]. [illegible]

by M. Konshnoff.—M. Grandidier was elected a member of the Section for Geography and Navigation in place of the late M. Dupuy de Lôme.

SYDNEY

**Royal Society of New South Wales**, May 6.—Annual Meeting.—H. C. Russell, B.A., F.R.A.S., President, in the chair.—The report of the Council stated that 34 new members had been elected during the year, making the total on the roll [illegible]. Sir G. B. Airy, K.C.B., F.R.S., and Prof. John Tyndall, F.R.S., had been elected Honorary Members in the room of Sir [illegible], K.C.M.G., and George Bentham, C.M.G., F.R.S., deceased. The sum of 380*l*. had been expended on books and periodicals during the year. The Clarke Memorial Medal for 1885 had been awarded to Sir J. D. Hooker, K.C.S.I., C.B., and the Society's Medal and a prize of 25*l*. to Mr. W. [illegible] for his paper on the water supply in the interior of New South Wales. [illegible]

## CONTENTS

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[illegible]

... at least ...

[illegible]

... rather than that we should wait for a generation for the knowledge to become available in the hands of the students.

It is no doubt very difficult to introduce new methods and to banish old ones, except by the introduction of young blood; but even so, something may be done in the way of preparing the minds of the older workers to re-

... mode of production and growth of hair or wool.

The second lecture is chiefly devoted to a description of the various breeds of sheep and of the results of cross-breeding.

In the third lecture the author describes the typical structure of wool fibre under the two heads: (a) in regard

[illegible]

they are obliged to take a [illegible] course; and, when a slight obliquity has once been established, every pulsation will tend to increase the spiral, and every movement of the [illegible] of the mother will be taken advantage of, the cord and fœtus revolving together until, with the growth of the fœtus, the friction of the amnion puts an end to the rotation.

[illegible] the embryo [illegible] the sections. [illegible] the state of [illegible] whether these [illegible]

[illegible] The books and papers [illegible] analysed and indexed; and [illegible] by the text, its corresponding number is given in the margin for reference.

F. J. ALLEN

## OUR BOOK SHELF

[illegible] By H. Ling Roth [illegible] Mackay Planters' Association. [illegible] March and April, [illegible]

[illegible] people that when [illegible] there are never [illegible] with suggestions for the [illegible] but practical [illegible] to the object of their purpose [illegible] common sense alike [illegible] the same [illegible] substituted [illegible]

[illegible] ready to take the task in hand should opportunity offer.

The facts narrated on p. 2 of the paper are anything but encouraging to those who would seek Government aid. Much can be done by Governments, and it may be that when corporate bodies realise that pests of the category of those now occupying our notice are formidable even as an armed force, they will see fit to turn attention to them.

TERS TO THE EDITOR

omenclature of Elasticity

[illegible]

[illegible]



[illegible]

[illegible] ... both sides of the scratch ... [illegible] ... NATURE.

[illegible]

[illegible]

## Spectra Produced [illegible] Scratching

[illegible]

Rainfall of N.W. England

[illegible]

MR. [illegible]

[illegible]

during the entr'acte between the past and coming scene of the sublime drama which Nature performs on the great stage of heaven: now faint, then strong, soon symmetrical, soon serpent-like, in one moment split into three or four arcs, and again gathering into one, now woven with all the lovely colours of the rainbow, now throwing forth rays and resembling the ornamental pipes in an enormous organ—such is the spectacle [illegible]

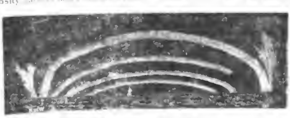
[illegible]

different. Here is a general description of a weak aurora:—

"The sun set some hours ago. The purple glow in the west has disappeared, myriads of stars stud the dark canopy. Far down on the horizon, in north-west and north, lies a faint vague cloud of light, upwards and downwards fading into the sky . . .

"Soon after, tiny spots of intense light begin to appear in the luminous cloud, while at times the entire oscillating luminosity disappears from the sky. But still the light is

[illegible]



nation-needle indicates the direction of the magnetic pole. At the present time in [illegible] the [illegible] 18 to the west of true [illegible] [illegible]

[illegible]

the [illegible] brilliancy [illegible]

[illegible]

[illegible]

[illegible] attain their greatest frequency and highest development at certain periods. Thus it appears from the observation of the previously mentioned French expedition to Bossekop, that the arcs appear on an average at [illegible], the streamers at [illegible], the auroral clouds at [illegible], the auroral waves between 13h. 12m. and 13h. 53m.

[illegible] the month of the Chinese twenty-eight constellations. The last month of autumn, according to the Hsia calendar, is the ninth month, the month after that [illegible] which contains the autumnal equinox.

The constellation Fang extends from about π to σ Scorpii, a distance measured along the ecliptic almost [illegible] the limits of [illegible] were as

Between 184 12 and 189 12
[illegible]

[illegible] constellation [illegible]

[illegible] On October [illegible], the fifty-first of the cycle of days, [illegible] there was an eclipse [illegible]

[illegible]

[illegible] Chung K'ang [illegible]

[illegible]

## NOTES

[illegible]

... since 1820.

The third session of the International Geological Congress, which was postponed last year on account of the cholera on the Continent, is fixed to be held this year on Sept. 28 at Berlin, under the honorary presidency of the ... Rhine ... [illegible] ... Dr. H. von Dechen. The President of the Organising Committee ... Beyrich, and the General Secretary M. ... Invalidenstrasse, Berlin.

[illegible] ... the requirements of ladies going up for the Preliminary ... the Intermediate or Full B.Sc. examination ... of London, under the new regulations, the ... College, York Place, Baker Street, London, ... complete course of instruction in biology, to ... Mr. A. G. Bourne will give lectures ... and will also have classes for demonstration. ... will lecture on vegetable biology, and Miss ... Newnham College, will give practical demonstrations ... Provision is also made for adequate ... candidates of science required for the same ... mathematics, physics and chemistry, the two ... work.

[illegible] ... the Royal Horticultural Society writes to ... this society are prepared to offer their co-... to such of the colonies as may desire as ... examples of the indigenous flora in ... The council, believing that collec-... economic plants in a growing state, and ... much interest and value, will be ready to ... assistance in preparing, arranging, and ... to any of the colonies who may [illegible]

[illegible] ... in early and with unusual force ... and about the usual time in ... Western India they have been later in ... in amount. Thus far, therefore, ... of this year's south-west monsoon, ... snowfall on the Himalayas has been [illegible]

[illegible] ... is anticipated will be of import-... on Monday night exhibited in ... Palace by Mr. Eric S. Bruce, the ... the application of electric lighting to ... may be flashed at night ... practical demonstration ... Mr. Bruce delivered a brief ... at the Albert Palace, in which he ... and explained the manner ... The invention consists of an ... material as translucent as possible ... on exhibition the material is ... a number of incandescent lamps, ... and the rope which secures it is ... electric current to the lamps made ... system of telegraphy is employed for ... the balloon with flashes of light ... The invention dates back only ... were made with a large balloon ... and were completely successful. It ... of signalling for a month. ... in introducing the electric ... by the highly inflam-... with which the balloon is inflated. This ... successfully accomplished. During the even-... including "God Save the Queen," "Rule Britannia," and "Health and Happiness to Princess Beatrice," were flashed from the balloon.

On Thursday evening last, July 16, Finsbury Technical College was *en fête*, the students having organised a *conversazione*

[illegible] India, presented by Mrs. [illegible]; an Erxleben's Monkey [illegible] from West Africa, presented by Mr. [illegible]; a Black-headed [illegible] from South America, presented by Lady Kensington; [illegible] from West Africa, presented by Mr. [illegible]; three [illegible] Puffins [illegible] from Ireland, presented by the Rev. [illegible]; a Long-eared Owl [illegible] European, presented by Mr. F. Allen; three Angulated Tortoises (*Chersina angulata*), an [illegible] from South Africa, a Black Sternotherc [illegible] West Africa, presented by the Rev. [illegible]; two King Vultures (*Gypagus papa*) deposited; an Axis Deer (*Cervus axis* [illegible]), [illegible] born in the Gardens.

## [illegible]RONOMICAL COLUMN

[illegible] — The first and [illegible] year of the [illegible] have been published as a single number [illegible] of the Continental [illegible]. The astronomical work accomplished [illegible] a Report from the Bureau of Calcula[illegible] of the Transit of Venus Commission [illegible] in the reduction of the observations [illegible] Dr. B. A. Gould, with the authority of [illegible] Argentine Republic, has offered the [illegible] Catalogue formed from the Cordoba [illegible] gift carrying with it the sanction of the [illegible] being printed therefrom at such [illegible]. All the errors detected up to the [illegible] have been corrected on the [illegible] to add that this valuable gift has [illegible] will preserve the collection [illegible] death is announced of Dr. T. Clausen [illegible] of Dorpat; amongst many [illegible] to astronomical science, his [illegible] of Lexell's comet of [illegible] from Bessel the [illegible] Cometen von 1770; etc. [illegible] will [illegible]

[illegible] this Society will be held at Geneva, under the presidency of Prof. Auwers.

Mr. Barnard of Nashville, U.S., having [illegible] small telescopic comet, on July 7, [illegible] at Harvard College on July 9, [illegible]

[illegible] R.A. 17 17 18[illegible]; Decl. [illegible] communicates the following observations [illegible] in Rome: —

Rome M.T. : R.A. 17 12 52 35 ; [illegible] 7 32 15[illegible]

[illegible] nucleus [illegible] in the preceding [illegible]

[illegible] uncertain, from the [illegible]. The [illegible] by Mr. Chandler from [illegible]; the resulting date of peri[illegible] in [illegible] the above ob[illegible] on July 15, made by [illegible] that the comet may not [illegible]. In this uncertainty we defer [illegible]. In any case the comet can [illegible] interest. The theoretical [illegible]

At the time of writing, no ephemeris to [illegible] the comet of its approaching [illegible] has been published, beyond [illegible] which [illegible] in this column [illegible] the perturbations during the actual revolu[illegible] very sensible. If it should prove that no [illegible] comparison of the perturbations has been effected, it will be [illegible] of the [illegible] heavens [illegible] in August, and just before morning twilight. The period of revolution of this comet [illegible] perihelion passage in December 1871, was 5035 days, which, without perturbation, would indicate September 24 as near the date of next perihelion passage.

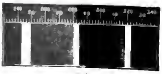
[illegible] are shed while the fish are swimming [illegible] water. The males swim indiscriminately [illegible] sometimes over, sometimes under them, [illegible] through which the shed eggs are slowly [illegible]. Eggs were pressed from a ripe female [illegible]. [illegible] developed normally, but [illegible] hours in a small glass [illegible] under the microscope, began [illegible] figured by Ryder [illegible] Report U.S. Fish Commission [illegible] temperature has a similar effect on other [illegible] on the surface are naturally [illegible], like the Salmonidæ, are capable of [illegible] to a certain extent. A [illegible] at one time, and if the [illegible] are incapable of being fertilised. [illegible] egg has a milky appearance and is [illegible] the fertilised one, so that by a little [illegible] distinguished without the aid of a microscope [illegible] to the bottom. [illegible] immediately after extrusion, but [illegible] and sink to the bottom in twelve [illegible] no change was observed [illegible] the small oil-vesicles around [illegible] primitive condition. [illegible] float in a dense mass, which [illegible] they are suspended [illegible] lie at the bottom [illegible] were either dead or dying. [illegible] With the sea perfectly calm [illegible] with a slight ripple the [illegible] feet under the surface [illegible] specific gravity than sea-water [illegible]

[illegible] as it [illegible] the water [illegible] The observations [illegible] the spawn is shed while the [illegible] freely in the water, and that the eggs [illegible] to the surface [illegible] found [illegible] To show the facility [illegible] herring [illegible] water which [illegible] fertilise each [illegible] found that though [illegible] the second or third [illegible] from the sand, in which the herring [illegible] introduced with the [illegible] eggs developed exactly [illegible] As Ryder [illegible] eggs unfertilised, [illegible] from the sea.

[illegible] development of the Herring [illegible] known on the subject, as [illegible] his own investigations. He also sends [illegible] the Board. Dr. M'Intosh [illegible] himself [illegible] by his scientific [illegible] St. Andrews [illegible]. Prof. Cossar Ewart reports on [illegible] progress of Fish-culture in America, and Mr. Young on the Northern and Western Salmon Rivers. The Report is both interesting and encouraging. It is difficult to form an adequate idea of the immense importance of their sea-fisheries to the people of Scotland. But it may be stated that about half a million of people, or about one-seventh of the entire population of Scotland, are connected with this industry, and more or less

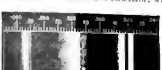
the early morning, and [illegible] apparently [illegible] believes that the eggs were shed and fertilised. One day, for example, there were no eggs visible on the surface of the water at 6 p.m., while a considerable number were obtained at 7.30, which, as the germinal disk was not completely formed, had in all probability been quite recently shed while the fish had been swimming about the tank in groups. From the observations made, it seems, as suggested by Sars, that

... [illegible] ... n reached a change rapidly came ... next trial mixture—samaria 35 ... of the samarium spectrum that ... the two faint green bands next ... the new orange line, which shone ... ver.



... [illegible] ... then change of spectrum occurs ... mixture.

... of 44 parts samaria and 56 parts ... is the pure samarium spectrum ... 58 yttria is built up of some of ... ctrum of each earth; whilst the



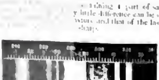
... yttria is almost a pure yttria spec- ... running across them all.

... Test for Samarium.—Experi- ... with the object of getting some ... of how small a quantity of

... the proportion of 1 part sama-

... The spectrum is very brilliant, ... to the spectrum given by a

... containing 1 part of samarium ... little difference can be detected ... xture and that of the last. The ... sharp.



of experiments were ... tried on mixtures of ... and yttria in different proportions, and the results are given in full in the paper.

Up to mixtures of 45 parts samaria and 55 parts yttria the spectrum nearly resembles the best samarium spectrum. Not a band of the yttria spectrum could be detected, and the brilliant orange line stood out sharply in the whole series. This spectrum is represented in Fig. 4.

A mixture containing 1 part of samarium to 10,000 parts of calcium was next tried. The bands are now getting fainter, ... of ... and the continuous spectrum ...

The next mixture ... one part of samarium to 100,000 parts of calcium. Here the green is almost gone, being overshadowed by the continuous spectrum of calcium which has

[illegible]

## SOCIETIES AND ACADEMIES

### London

**Chemical Society**, June 18.—Dr. Hugo Muller, F.R.S., President, in the chair.—Messrs. Jas. F. Bennett and Harry M. Elson were formally admitted Fellows of the Society.—The following gentlemen were duly elected Fellows of the Society:—[illegible] Thomas Cradock Hepworth, Leonard [illegible] Langer, Arthur Richardson, James Sharp, [illegible] James Spilsbury.—The following papers [illegible] decomposition and genesis of hydrocarbons [illegible] i.e., the products of the manufacture of [illegible] by Henry E. Armstrong and A. K. Miller. [illegible] the examination of the various products of petroleum effected at high temperatures, [illegible] oil gas (see paper in the *Journal* of the [illegible] Industry, September, 1884), as far as can [illegible] the material originally dealt with, the [illegible] these methods and results, they remark, must be regarded as little more than pre[illegible] will be necessary to repeat the investiga[illegible] scale, and to introduce new and improved [illegible] ducts examined are (1) the portion of the [illegible] combines with bromine; (2) the liquid [illegible] compression of the gas to about ten atmo[illegible] tion of the tar which is volatile in steam. [illegible] constituents of the mixture of bromides ob[illegible] the compressed gas by bromine are ethylene [illegible] tetrabromide, $C_4H_6Br_4$; [illegible] [illegible] also been separated from it. The gas [illegible] hydrocarbon of the acetylene series capable [illegible] in an ammoniacal cuprous solution. [illegible] during compression of the gas is a com[illegible] of hydrocarbons of the $C_nH_{2n-6}$ series, [illegible] the presence in it of *normal* amylene, [illegible] has been demonstrated by the study of [illegible] of the various fractions. It is [illegible] contains a considerable quantity of the [illegible]; this latter hydrocarbon has not been [illegible] boils at 45°, and yields a tetrabromide [illegible] alcohol in long flat prisms melting [illegible] to separate a hydrocarbon having the [illegible] hexylene from the fraction boiling [illegible] been unsuccessful, the statement [illegible] of the authors that this hydrocarbon was [illegible] based on determinations which have since [illegible] faulty. The liquid deposited during com[illegible] rich in benzene and toluene, but contains [illegible] benzenes. (3) The steam distillate from [illegible] less volatile hydrocarbons present in [illegible] during compression of the gas, together [illegible] of others. It is rich in hydrocarbons which [illegible] by sulphuric acid; these appear to be [illegible] the $C_nH_{2n-2}$ series, such as Schorlemmer [illegible] oils from cannel and boghead coal, and [illegible] higher than acetic on oxidation. The three [illegible] and pseudocumene are present in about [illegible] portions as in ordinary coal-tar; but in addi[illegible] contains certainly one—probably two—*higher* [illegible] series; the amount obtained has not [illegible] to permit of the precise determination [illegible] considerable amount of naphthalene may [illegible] hydrocarbons of higher [illegible] to have also been obtained in small [illegible] although relatively small, amount of a [illegible] saturated hydrocarbon has also been [illegible] the quantity of material at their dis[illegible] the authors to separate them in their [illegible] efficiently approaching purity; they [illegible] however, that the mixture does not [illegible] of hydrocarbons of the $C_nH_{2n}$ series [illegible] chief constituents of Russian petroleum, [illegible] are by no means the sole constitu[illegible] examined, but merely those which have been [illegible]

The theoretical conclusions to be deduced [illegible] in some respects interesting. It would [illegible] are present, and it is also re[illegible] only this series is not represented by terms [illegible] No true [illegible] have been detected [illegible] the [illegible] either [illegible] $CH_3 \cdot CH{:}C{:}CH_2$, or *unsymmetric allene*, [illegible], and from their behaviour on oxidation it is probable that the homologous hydrocarbons are closely related to it. Hence it may be inferred that in the formation of hydrocarbons of the $C_nH_{2n-2}$ series at high temperatures from normal olefines of the formula [illegible] two atoms of hydrogen are removed in such a way that the terminal $CH_2{:}CH$ [illegible] in the formula becomes either

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# NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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

No. 822, Vol. 32] THURSDAY, JULY 30, 1885 [Price Sixpence

Registered as a Newspaper at the General Post Office]







true Lycopodiaceæ, the chain
the more direct and complete.
of exogenous zone increased for
was quickly arrested by the
in some way of the Cambium
increase in diameter took place
stem, and to it the growth and
principally due. The exogenous
own tiers is thus seen to have
climate, for had it persisted in-
generation of fresh layers or new
e produced true dicotyledonous
of rigid seasons, or alternations
duced the earlier uniformity of
th would have been of relatively

observed specimens of Sigil-
still more definite exogenous
also M. Renault finds that the
dotted punctæ similar to those
vessels of Cycads and Arau-
of their stems agree in so
of the highest heterosporous
... that the difference
... Moreover, the
... in the direct line of
... an offshoot which was
... in the Carboniferous time
... side by side with them.
... is greatly varied, and it
... of growth was susceptible of
... development. It is
... some Sigillarias are
... we find a remarkable
... them
... as well as roots,
... merely roots
... were preeminent
... holding
... and crowned
... whose scars, im-
... complex and beautiful
... their fruiting
... is unfor-
... known

... petrous stems, that of
... more ab-
... stem with verti-
... in appearance a gigantic
... irreconcilable
... the French authors and
... the former separate Calam-
... them to have been
... of the interior of
... present the same
... though morphologically
... they maintain to be a
... and without
... Prof. William-
... has ever been found, but
... be, they
... if any as pre-
... are but remark

[illegible]

## OUR BOOK SHELF

[illegible]

## LETTERS TO THE EDITOR

[illegible]

### [illegible] W[illegible]

[illegible]

the *Sarracenia*, like some animals, can feed upon carrion and thrive upon it.

In instances in which experiments have been made with fresh, raw beef or mutton, the meat has been covered in a few hours with the secretions of the leaves, and the blood extracted from it. There is, however, one difference between the digesting powers of the leaves when exercised upon insects or upon meat. Even if the bodies of insects have become putrid, the plant, as has already been stated, has no difficulty in assimilating them; but as regards meat, it is only when it is perfectly sweet that the secretions of the leaves will act upon it.

The Pitcher plant undoubtedly derives its principal nourishment from the insects it eats. It, too, unlike most other carnivorous plants, which, when the quantity of food with which they have to deal is in excess of their powers of digestion, succumb to the effort and die, appears to find it easy to devour any number of insects, small or large, the operation being with it simple [illegible] tion of time. Flies, beetles, or even cockroaches, at the expiration of three or four days at most, disappear, nothing being left of them save their wings and other hard parts of their bodies.

The *Sarracenia* [illegible] food, not only the most voracious of all known species of carnivorous plants, but the least fastidious as to the nature of the food upon which it feeds.

W. C. M.

## THE ECLIPSE OF AUGUST, 1886

It has been before stated in NATURE that the total solar eclipse of August [illegible] 1886 [illegible] can be most favourably observed on the west coast of Africa [illegible] Benguela. In a recent number of *Science*, Mr. Stanner supplies a valuable account of the local conditions, which we here reprint:

"Benguela is about 400 miles south of the mouth of the Kongo, and about [illegible] miles south of the mouth of the Kwanza. The [illegible] of the lowlands bordering the coast near Benguela [illegible] [illegible] for [illegible] making it compulsory on the score of prudence, for an observing party to penetrate the interior sufficiently to attain the mountainous [illegible] inland.

"The American Board of Commissioners for Foreign Missions has for some three years occupied [illegible] stations in the region, viz. Bailundu, about [illegible] miles eastward from Benguela, and Bihe, about [illegible] miles south-east from Bailundu. Through the courtesy of Rev. Judson Smith, D.D., secretary of the American Board, and Mr. Frederick A. Walker, secretary of the [illegible] central African Mission, I have received definite statements of some of the precautions necessary, and some of the difficulties to be encountered by an observing party locating in this region. I will give in brief the points with which Mr. Walker [illegible]:

"[illegible] to the person from [illegible] are not to be apprehended. The [illegible] of [illegible] and [illegible] is exceedingly [illegible]. During a residence of nearly three years, Mr. Walker and his family have experienced no illness to be ascribed directly to the climate, but in every case to overwork, over-exposure to the sun, or want of proper food.

"The difficulties on [illegible] in transportation are considerable. Transportation is done entirely by men; waggons and animals cannot be used. The [illegible] weight for a carrier is from [illegible] to [illegible] lbs.; [illegible] it does not exceed [illegible] lbs. [illegible] boxes or boxes, should be of about the following dimensions:—[illegible] inches by [illegible] inches by [illegible] inches, or, if more convenient, [illegible] inches by 10 inches by 21 inches. No single package should exceed [illegible] inches in width by [illegible] inches in depth. Pieces not exceeding [illegible] [illegible] feet long, can be carried by a single carrier.

"As to means of subsistence, an observing party must bring all their supplies with them, as it is essential to the health of newcomers that they should live on food to which they are accustomed. The time required for a round trip of a caravan from Bailundu to Benguela may be stated as one month to six weeks.

"Mr. Walker states that the chances for clear sky at the time of the eclipse are very favourable.

"It may be stated that the land rises very abruptly as one leaves the coast from Benguela, and in a few miles attains a very considerable altitude, and throughout these highlands the climate is very healthful."

## INTERNATIONAL INVENTIONS EXHIBITION

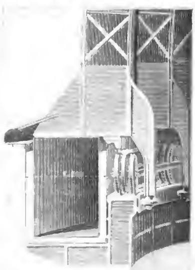
SELF-ACTING or automatic machinery has made wonderful strides of late years, and its progress in the special department of watch-making cannot be more advantageously studied than in the beautiful display of machine tools now exhibited by the American Waltham Watch Company at South Kensington. We think that a few remarks with reference to the functions of these tools may be of service to the readers of NATURE when [illegible] the collection. The machine tools are all [illegible], and can readily be identified.

(1) A screw-making machine.—This machine is engaged in producing watch jewel screws; the size of the [illegible] be appreciated when we state that it takes more than [illegible] to weigh one ounce troy. Lengths of [illegible] to be transformed into these tiny screws in the following manner. The machine [illegible] fed with the wire through a hollow [illegible], the wire is seized and rotated rapidly, a movable cutter is brought against it, and immediately the body of the screw is turned. Two dies are at hand which [illegible] and they cut the thread; on reaching the [illegible] of the screw [illegible] pull out the wire a distance [illegible] to the length of the body of the screw through [illegible] hitherto the wire has [illegible] themselves, and [illegible] head. There is an alternating arm, the most [illegible] of the [illegible]: this takes possession [illegible] cut off, and, carrying it to a different part of the machine, holds the head against a small [illegible] the [illegible] is cut. The screw is now finished, and is [illegible] into a magazine in a kind of [illegible] the [illegible] with so much rapidity, that [illegible] to follow them. It is to be noticed [illegible] cutting, the wire is stationary, and the machine [illegible] motion to [illegible] time. When the dies pull forwards, the chuck holding the wire opens [illegible]. Copious streams of oil are supplied to wash away the [illegible], and the oil after being used once, [illegible] from whence it is automatically pumped [illegible]. The different parts of the machine are [illegible] almost entirely by cams, the dies by a very [illegible] toothed sectors.

[illegible] attachments. If this machine [illegible] would be interesting, but it [illegible].

(3) [illegible] staves or pinions.—This [illegible] to the screw-making machine. [illegible] the mandrel, and a cutter shape [illegible] pinion, giving it a male centre. [illegible], but the other end has to be shaped with [illegible]. Again we have an alternating arm, which carries the pinion away and places it in a very [illegible] mandrel on the other side. So soon as it is gripped it begins to [illegible], a cutter comes and shapes the unfinished end with its male centre. When done it is discharged into a magazine, as the tiny screws were.

(4) This is a machine for turning down the staves or



[illegible]

[illegible] Liquid and Solid Bodies, the other on [illegible] to have a series of critical papers [illegible] as far as possible and desirable on [illegible] knowledge of these subjects, and also [illegible] which investigation is specially re[illegible] carried on. These subjects [illegible] of general interest and of special [illegible] and in the hope of inducing chemists [illegible] in attacking the many problems [illegible] Abney will open the first dis[illegible] spectroscopic method. Prof. [illegible], Mr. S. U. Pickering, Dr. Russell [illegible] contribute papers. Professor Lodge [illegible] on Electrolysis, and Prof. Schuster, [illegible] have already consented [illegible] of this subject. Dr. Armstrong [illegible] other gentlemen who may wish [illegible] to be a useful departure.

[illegible] brought to this country from [illegible] independent of electricity, so that [illegible] quite dispensed with. This [illegible] working of the instrument, and [illegible] which was recently subjected to a [illegible] the chief [illegible] consists of a diaphragm, or [illegible] of willow wood, which has been [illegible] remarkable sensitiveness to [illegible] of wood are closely woven [illegible] the centre of the diaphragm [illegible] which the wire proceeds [illegible] the instru[illegible] the ticking of [illegible] heard with

[illegible] Board for Scotland, in order to [illegible] other countries for increasing [illegible] when on the [illegible] some of the principal [illegible] It will be remembered [illegible] Canada and the [illegible] to his Board a [illegible] culture in America." [illegible] the Norwegian fisheries may be

[illegible] the summer [illegible] Engineers will be held [illegible] the following days of the week, [illegible] reading and discussion [illegible] Mr. Jeremiah Head [illegible] by Mr. Joseph [illegible] adaptation of the Robey [illegible] John Richardson, of Lincoln; [illegible] by M. Louis [illegible] of electric lighting, [illegible] of Nottingham; [illegible] apparatus, by Mr. [illegible] A complete programme of [illegible] has been arranged.

[illegible]

Boston, Mass., U.S.A. CHARLES SEDGWICK MINOT

## NOTES

[illegible] Aberdeen. [illegible]

We [illegible] proposed excursion by the [illegible] under the direction of MM. [illegible] and Renard. The monthly circular, [illegible] which we learn that during the [illegible] days of the excursion [illegible] will be made to the typical sections of [illegible] Cambrian, Devonian, [illegible] including the

[illegible] tabled thus:—Winter, 12 (Dec., 2; [illegible], 15 (March, 8; April, 7; May, 0); [illegible] ly, 0; Aug., 4; Autumn, 19 (Sept.; [illegible] Spring and Summer together, 23; [illegible] gether, 31. The following localities [illegible] days:—Los Angeles, Cal., Jan. 4, [illegible] Francisco, Jan. 25, March 15, 25, July [illegible] Cal., March 25, April 17, 20; Eureka, [illegible] 11; Concord, N.H., Aug. 10, Nov. [illegible] causing much damage were Nov. 3, [illegible]; Nov. 22, Lima, and Aug. 10, [illegible]

[illegible] Stonyhurst College Observatory the [illegible] al and Magnetical Observations for [illegible] Perry, F.R.S. The work done at this [illegible] and more valuable every year. Of [illegible] were made during the year and [illegible] chromosphere. The spectra of sun- [illegible] 30 days, and the widening of 200 [illegible] measured.

A [illegible] ington Philosophical Society not long [illegible] posium, in which various members [illegible] on: "What is a glacier?" The fol- [illegible] itions given; but it should be men- [illegible] ations and suggestions in most cases [illegible] reproduce in full. "An ice-body, [illegible] lation of snow in regions where the [illegible] the loss by melting and evapora- [illegible] ow—and flowing to regions where the [illegible] the snow line [illegible]; [illegible] like the aqueous river, of movement [illegible]; "A mass of ice with definite [illegible] in a different direction, and origin- [illegible] of snow by pressure" [illegible] [illegible] each precision of expres- [illegible] that hard-and-fast lines of [illegible] but rather gradations of [illegible] were probably used by [illegible] "There is an area of [illegible] glacier, superficially the [illegible] the area of waste is [illegible] Mr. McGee said that as glacier ice [illegible] the two phases can [illegible]. "Perhaps the most satis- [illegible] to the snow-line, above [illegible] by precipitation, and below [illegible]

[illegible] the receipt of the third Biennial [illegible] the Iowa Weather Service, as [illegible] and monthly bulletins issued [illegible] The appropriation for the work [illegible] a large number of volun- [illegible] to a list of [illegible] of his volunteers [illegible] June 10, 1882. He was a [illegible] reports in fine hand- writing.

A FEW days ago [illegible] weighing 28 lbs. was netted at [illegible], which was marked under the left [illegible] A. Probably the [illegible]

MR. JOHN WHITE, of Great Queen Street, has sent us Part I. of his Catalogue of Botanical Works. It extends to 84 pages and contains [illegible]

... the name of "aniline ... This substance is evidently ... gives the characteristic reaction ...

The preparation of this from the mauve dye was, however, too costly to allow of its being brought into general use. However, new processes have been since discovered, by which this or other colouring matters of its class can be produced cheaply.

## SOCIETIES AND ACADEMIES

CONTENTS

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edition, is incomprehensible, ... the assumption that both with respect to his father's ... reports ...

... suggestive of anything ...

## Earthquake Proof Buildings

## A Mechanical Telephone

## LETTERS TO THE EDITOR

## Nomenclature in Elasticity

## Electrical Phenomenon

[illegible] from the two men [illegible] Smythe to the [illegible] to afford very good [illegible] immediate advantage [illegible]

[illegible] Mr. James Lick was [illegible] which [illegible] the fact that [illegible] of the [illegible] the largest [illegible] of the best [illegible] observatories, [illegible] and isolated [illegible] would have found [illegible]

[illegible] next to the work of the [illegible] the telescope itself. [illegible] of the current volume of [illegible] the very reasonable grounds for the belief that the [illegible] of the Lick trustees, in so far as they [illegible] to the construction of the great telescope

[illegible] this [illegible] workers [illegible] deeper [illegible] results [illegible] formed [illegible] Academy [illegible]

[illegible]

[illegible] Crustacea [illegible] Audouin, and [illegible] this group.

The "Histoire naturelle des Coralliaires" [illegible] commenced after Milne-Edwards's return [illegible] a collecting tour on the coast of [illegible] order to study the cells of [illegible] Jules Haime, so well known for his memoirs on the Polyps in the Palaeontographical Society of London and in the *Annales des Sciences Naturelles*, with him in this work; but the death of Haime in 1856 compelled Milne-Edwards to complete the work himself. It is in a few tender words dedicated to the memory of Jules Haime.

"Leçons sur la Physiologie et l'Anatomie comparée de l'Homme et des Animaux" were published between 1857 and 1881, in fourteen volumes. The series is dedicated to his friend, M. J. Dumas, to whom he had dedicated the first work of his early pen. These lectures will always possess an importance to the student, from the immense mass of details, accompanied with copious references to the labours of others, that are brought within a limited compass.

"Recherches anatomiques et zoologiques faites pendant un Voyage sur les Côtes de la Sicile, &c.," forms a splendid quarto volume of over 800 pages, which are illustrated with nearly 100 coloured plates. This work is, for the most part, a corrected report of a series of memoirs contributed to the *Annales des Sciences Naturelles* by Milne-Edwards, A. de Quatrefages, and Émile Blanchard.

There can be little question that the name of H. Milne-Edwards will always rank high among the naturalists of the first half of the nineteenth century, and for years he was the [illegible] one of the leaders of zoology. He was among the first who [illegible] the study of the dead forms of animal life, made prolonged visits to the sea-coasts to study the living forms and to investigate the [illegible]. These were days before zoological stations were thought of and when the details of geographical distribution were little known. That Milne-Edwards's study of the geographical distribution of the lower forms of [illegible] led him to the theory of there being centres [illegible] view [illegible]

[illegible]

[illegible] he was the possessor of a [illegible] of which were most freely [illegible] He was a member of most of the learned [illegible] of Europe and America, and the possessor of [illegible] of Science. Full of years [illegible] As Geoffroy [illegible] succeeded by his son [illegible] Milne-Edwards [illegible] his name and [illegible]

## [illegible]

IT [illegible] that a [illegible] light and [illegible] been known [illegible] light may yet [illegible] they at once [illegible] of which we [illegible] These may be put in the form of [illegible] questions:

1. [illegible] what is it?
2. [illegible] move through space?
3. [illegible] radiant light?
4. What [illegible]
5. In what manner [illegible] of radiant light and heat related to the [illegible] the body?

[illegible] was the first to

[illegible]

[illegible]

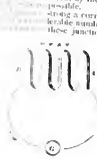
indeed, it is abundantly evident [illegible] not the absolute temperature of [illegible], but only the difference in temperature between the [illegible].

Delicate as this instrument [illegible] to be, it forms but a poor substitute for the human eye, and had it not been for a new discovery, we should not have been able to make much progress in our knowledge of dark heat. The discovery alluded to is that of Seebeck,

[illegible] circuit, composed of two metals [illegible] current of electricity is produced when [illegible] heated, while the other is kept cool. [illegible] be simultaneously heated to [illegible] current is produced.

[illegible] instrument similar in principle [illegible] other words, a new species of [illegible] and we shall now show that this [illegible] of being made extremely delicate [illegible] differences of temperature. The [illegible] of electricity is easily known [illegible] magnetized needle, which tends [illegible] angles to the direction of the [illegible] we have a circuit (Fig. 3), in [illegible] and $B$ bismuth, and that we heat [illegible] the Figure. We shall have, in [illegible] current following the direction of [illegible] north pole of the needle will be [illegible] as indicated in the Figure. [illegible] magnet to measure a current we [illegible] galvanometer. Our object, therefore, is clearly to get as large a [illegible] a small temperature difference, [illegible] current by means of a galvano[illegible] possible.

[illegible] strong a current as possible we [illegible] considerable number of junctions, as [illegible] these junctions are very close

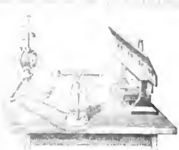


[illegible] influence is applied to the [illegible] lower ones are kept cool. [illegible] two suitable metals for our [illegible] metals the heating of which [illegible] current. This is done by con[illegible] of metals; in other words, a [illegible] current shall go across the [illegible] metal nearest the top to that [illegible].

[illegible] of this nature:—

[illegible] Silver.
Zinc.
Iron.
Antimony.
Tellurium.

[illegible] law which holds with [illegible] for instance, we have a com[illegible] in Fig. 3 connected with a galvanometer, we shall get the same current [illegible] by heating through [illegible] the copper and [illegible] junction, and also the tin and antimony junction, [illegible] we shall in the opposite direction by heating the antimony and copper junction. In other words, the various metals in the above list are to be regarded as being at so many different levels, and the strength of the current depends upon this difference of level, and not at all upon the exact number of [illegible] places we make use of in



[illegible]

... a very different result. In the first place the rays will be [illegible] by the prism, so that the screen will have to be placed in a very different position in order to receive the

[illegible]

What we have to do is to measure the amount of heat-energy possessed by the various parts of the spectrum, and this is done by allowing the rays in question to fall upon a suitable thermopile covered with lamp-black and then measuring the amount of heat to which they give rise by means of the indication of the galvanometer attached to the pile. A coating of lamp-black absorbs most of the rays, and if it is not absolutely

[illegible]

... to 313. ... in the working of these examinations, by which they are rendered more practical, and at the same time better adapted to the

... in Philadelphia ... in Maryland ... along the ... It wrecked ... in Maryland and Delaware, doing the greatest injury along the Delaware river front of Philadelphia. Passing from south to north, a low, black, revolving ball of smoke moved at the rate of nearly a

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885

[illegible] longer apprenticeship [illegible] very chemist [illegible] say longer than this. There [illegible] efficient men are wasted, they are not to be found, and they have to be got from abroad. In my address to the Chemical Society this year, I referred to the past neglect of research at our chemical schools, so that I need not speak further on that aspect of the subject here, though it is an important one in relation to our industries.

There is no chasm, as we have already seen, between pure and applied chemistry; they do not even stand side by side, but are linked together, so that a technical chemist needs to be a thorough chemist, and unless we employ such men

[illegible] and in the same time [illegible] receive further benefit. This linking together of industry and theoretical chemistry has undoubtedly been the great cause of its wonderful development. We now have not only all the colours of the rainbow, but we have also the more [illegible] not less useful, colours, and, moreover, there are also a great variety of products of similar colours possessing different properties which fit them for special uses. This industry is also one of no mean dimensions. I have not been able to get any very recent statistical information on this subject, but notwithstanding the great reduction of prices of the products of late years, yet owing to the extended development it has undergone, the value of the annual output has probably

CONTENTS

IMPORTANT ANNOUNCEMENT.

# HARVEY'S MANUSCRIPT LECTURES

...l College of Physicians in and after 1616, we... ...tions of Harvey's discovery of the circulation... ...h natural science. So important, so interest... ...h much satisfaction that Messrs. Churchill &... ...of the lectures, accompanied by an interleaved... ...of which affords good guarantee of thorough... ...undertaking has been undertaken by Mr. ... ...he price of the work will be £1 12s. 6d. ... ...t will be limited, and must be forthwith decid... ...No exact promise can be made as to date... ...in the spring of next year.

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Sir Henry Pitt, Bart.

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...By Chiyomatsu Ishikawa,...

...By Alfred ... Anatomy in University College, London.

...(With Plate.)
By W. D. Halliburton, M.D., B.Sc.,...

...of Trinity College, Cambridge. (With a Pl...

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THURSDAY, AUGUST 13, 1885

## DR. LAUDER BRUNTON'S "PHARMACOLOGY"

*A Text-Book of Pharmacology, Therapeutics, and Materia Medica.* By T. Lauder Brunton, M.D., D.Sc., F.R.S., &c. Pp. 1139. (London: Macmillan and Co., 1885.)

IT is nearly twenty years since Dr. Brunton, then a student in the University of Edinburgh, commenced, by his researches on the physiological action of digitalis, which were followed soon after by others on nitrite of amyl, a life of laborious work which has been marked at every stage by contributions which testify to his scientific acumen and his burning love for research, and which have enriched physiology and many branches of medicine with newly-discovered facts.

Now, when the second decade of his professional life is drawing to a close, he presents us with a work which stamps him as a teacher in the highest sense of the word.

It may appear to some that an apology is needed for introducing into the columns of NATURE a review of a work dealing with departments of medicine. To any such we would reply that it falls within the scope of this journal to review the progress of all departments of natural science, and that large sections of Dr. Brunton's book are full of interest to all biologists, and almost as much to the specialised physiologist as to the practical physician.

By the term "materia medica" it has long been the custom to designate the study of the agents, whether derived from the mineral, vegetable, or animal kingdoms, which are employed in the treatment of disease. By "therapeutics" we understand the study of the application of these remedial agents to the cure of disease. Until very recently the study of therapeutics was based entirely on pure empiricism, and under conditions where empiricism (*i.e.* experiment), uncontrolled by theory and unassisted by proper methods of observation, could not but yield misleading and contradictory results. The physician employed a drug because others had prescribed it before and found it useful in certain diseases, possessing but rarely any knowledge whatever of the mode in which the drug would affect a healthy subject, or of the manner in which it affected the diseased organism. All that was taught concerning the action of drugs was based upon successive individual experiences, accumulated by individuals who were of necessity destitute of the scientific knowledge, as yet unexisting, which alone could make them "empirics" in the best sense of the word.

These observations are not intended to disparage the work of those who, sometimes possessed of marvellous intuition, worked in bygone days, nor to lead to the inference that old therapeutical experience was barren of useful results. However great the knowledge otherwise acquired of the action of a new drug, however stringent the reasoning which leads us to surmise that it is likely to exert a valuable influence in the treatment of disease, yet ultimately it is by a rational empiricism—*i.e.* by a rational and cautious series of observations on actual cases of disease—that its value will be determined; and, further, he alone will be worthy of the name of a good physician who, irrespective of theoretical considerations, bases his use of remedial agents on the results of rational empiricism. To the older therapeutic studies we owe our knowledge of the usefulness of such drugs as iron, cinchona, and digitalis, a statement which of itself is sufficient to express our obligations to the empiricism of bygone days.

There were many causes which, until lately, stood in the way of a proper study of therapeutics. It was only when the natural history of disease came to be studied by men imbued with physiological knowledge and furnished with all the appliances which physiology has borrowed from chemistry and practical physics that it became possible to lay the foundations of sound therapeutics. From such studies it appears that a morbid process is not to be looked upon as a morbid entity to be destroyed, but usually as the resultant of complex deviations in physiological processes; often, it is true, associated with structural alterations of particular organs which stand more or less closely in the relation of proximate causes of the diseased phenomena. They have shown that, in general, in the treatment of disease, the scope of the physician must be to combat particular phenomena by the use of agents affecting specially the organ and function which are the principal factors in the production of the morbid process.

In order, then, to place medicine on a proper basis, it was needed (1) that the functions of the healthy organism (*physiology*) should be studied in the full light afforded by anatomy, chemistry, and natural philosophy; (2) that the exact deviations of the several functions from the normal standard which constitute particular diseases should be ascertained with the utmost exactitude, not only so as to permit of accurate recognition (*diagnosis*) and classification, but to furnish the elements for a philosophical treatment; (3) that alterations induced in the structure of organs by disease (*pathological anatomy*) should be minutely observed, and that by the light of *experimental pathology*, the course of these alterations and, if possible, their proximate as well as their more remote causes should be ascertained; (4) that the so-called physiological action of drugs and other remedial agents should be submitted to a searching investigation: to this study the vague and misleading term of *pharmacology*, previously employed by German writers, has, unfortunately as we think, been applied; (5) that the subsequent application of drugs and other remedial agents to treatment (*therapeutics*) should be studied not only with the object of showing their influence on particular diseases, but also the way in which individual phenomena of disease have been modified.

All the above branches of inquiry are now being pursued by men imbued with the scientific spirit and furnished with all the scientific knowledge of the day. As a result, in spite of the great difficulty of the task, the physician is acquiring more and more that power of anticipating and predicting events which springs out of a knowledge of principles and distinguishes science from mere empiricism.

Until a comparatively recent period the study of the physiological action of drugs and consequently of therapeutics remained in a backward condition, wh

[illegible]

... modified [illegible] a definite manner, and the action [illegible] under these circumstances, as in [illegible] on drugs affecting the organs of circula[illegible] which the vagus is cut or stimulated. Pharm[illegible] based on experiments thus made, and no one [illegible] book can doubt their value. [illegible] of the author on objections to experime[illegible] that we cannot avoid reproduc[illegible]

*[illegible] Experiment.*—Some people object [illegible] upon animals. They do this [illegible] The first is that such experiments [illegible] that even if they were useful, [illegible] pain upon animals. [illegible] is due to ignorance. Almo[illegible] action of drugs on the [illegible] the physiological functio[illegible] has been obtained [illegible]

[illegible] one which, if pushed [illegible] carried out, would soon [illegible] constantly going on [illegible] between man, the [illegible] very being depends [illegible]

We destroy them [illegible] or cobra, or destroy [illegible] them to work [illegible] we urge them [illegible] or flag [illegible] who should [illegible] thus save the [illegible] scaffold, even [illegible] end of the journ[illegible] for a cabinet [illegible] will take [illegible] without rega[illegible] Yet if one-tenth [illegible] endure in either [illegible] inflicted by a phy[illegible] knowledge which [illegible] then the life, not [illegible] many perso[illegible] as the [illegible] want of thou[illegible] They either [illegible] from exp[illegible] perhap[illegible] the utility [illegible]

[illegible] life and the [illegible] biology with [illegible] muscles, infusor[illegible] plasm found [illegible] devoted to [illegible] of the [illegible] special inter[illegible] their life-histo[illegible] by drugs. [illegible] the Invertebra[illegible] of our know[illegible] inquiry. [illegible] lengthy chapte[illegible] as applie[illegible] It is th[illegible] versatility, th[illegible] the writer [illegible] contains [illegible]

while a general review of the [illegible] of length measurement, in which other instruments and tools, including the cathetometer [illegible], are described, concludes the chapter.

This brief review of the first [illegible] to show the system on which each of the eight chapters is put together.

In the second chapter on angular measurement the [illegible] Vernier, the mirror and scale, and the [illegible] of course [illegible]. There is also a lesson on the simple and easily [illegible] instrument of M. Cornu, the optical lever.

The chapter on the estimation of [illegible] very complete, for, besides an explanation of the theory and use of the balance, there [illegible] "[illegible] weighing," a copy of which might well be placed on the wall above every balance in a laboratory; there [illegible] paragraph on the sensibility of the balance, [illegible] shows the observed sensibility of an Oertling, a Bunge, and another [illegible] balance. There is, lastly, a lesson on the error of [illegible] given the [illegible] of weights.

In the chapter [illegible] Amsler planimeter. This beautiful [illegible] instrument, as is well known [illegible] the area of [illegible] point is [illegible]. In a new edition [illegible] the new "[illegible]" planimeters [illegible] some other respects are superior [illegible] of Amsler will be described.

In Chapter V., on the determination of density, will be found all instructions for finding [illegible] solids and liquids by a host of methods. The [illegible] [illegible] taken of the [illegible] and the [illegible] level in calculating the density [illegible] from the [illegible] meter reading; further, the effect of [illegible] lighter [illegible] the air is guarded against. The hydrometers of [illegible], Hamm and Twaddle are described, and [illegible] directions are given for making [illegible]. The [illegible] termination of the density of a gas, being a problem of great difficulty, is considered unsuitable for students in the laboratory; however, an outline of [illegible] method is given.

The chapter on elasticity [illegible] [illegible] in the laboratory.

The chapter on the determination [illegible] [illegible] full account of the [illegible] [illegible] standard [illegible] for [illegible] not mentioned.

The last chapter, on time, gravity [illegible] the earth [illegible] mechanical. The [illegible] the [illegible] instructions are [illegible] for [illegible]. Clocks, chronometers, [illegible] watches, the [illegible], and the chronographs of Hipp, in which [illegible] vibrating [illegible] times [illegible] second [illegible] the pendulum of a clock, are briefly described.

The determination of *g* by Borda and by Kater's method is given. Several forms of electric chronograph are described—among them one in which a primary circuit is broken at the beginning and end of the interval to be measured, while the induced currents cause a spark to pass between the style of a tuning-fork and a smoked drum, so that the number of waves between the two dots produced by the sparks measures the time.

As has been already said, completeness and attention to detail are apparent in every chapter of the first volume, while the names of the authors are sufficient [illegible]. The only cause for regret is the fact that the public has to wait for the two volumes [illegible] physics, for those who read the first, which deals mainly with measurements of geometrical and mechanical properties, and which is therefore essentially an introduction, are likely to be impatient to see the series completed.

## OUR BOOK SHELF

*The History of a Lump of Gold from the Mine to the Mint.* By Alexander Watt. (London: A. Johnson.)

The author has endeavoured to treat his subject [illegible] general readers, but he might have [illegible] such moralisations, suggested by the word "gold," as: "With what silent rapture we [illegible] our own, and how different is the feeling when it comes into our hands merely to convey to another." The compilation of facts connected with the [illegible] of gold and its manufacture into coin has, however, been [illegible] done. Considering that the superstructure of modern chemistry was built up on the labours of the early alchemists, we object to their being described as "those remarkable impostors," and indeed the [illegible] the writings of the early chemists which are given abundantly prove their claim to more respectful treatment. The metallurgy of gold is dealt with in the [illegible] chapter relating to the operations [illegible] laboratory, and is confessedly [illegible] lectures recently delivered [illegible] of the Mint.

The important question of the amount of gold actually in circulation [illegible] sight of, and the author [illegible] passage:—"The amount of gold [illegible] circulation is estimated to be [illegible] returns show that the [illegible] half-sovereigns issued since [illegible] 247,521,429. What [illegible] of the one hundred and forty-seven [illegible]." No doubt a considerable proportion [illegible] never to return, but we do think, with the author, that the operations of manufacturing goldsmiths and jewellers would account for a very large proportion of the deficiency.

There are some remarkable slips in the printing. For [illegible] of the coinage is [illegible] and Sir John Pettus [illegible] as a whole, the work may [illegible] information [illegible] desirable should be widely known.

*[illegible]* By W. G. Baker. (London: [illegible] and Son.)

With the [illegible] of elementary text-books on magnetism and electricity already existing the production of a fresh one [illegible] an unnecessary task. Nor is there anything in the little book now before us in the least degree new, either in matter or in arrangement. So far as it goes, however, it is quite satisfactory. It consists of [illegible] pages, and in this space the author has managed to give in a clear manner an account of so much of the subject as might reasonably be put before a

## LETTERS TO THE EDITOR

### Pitcher Plants

[illegible]

... It is evident that chlorophyll ... by a process similar to that which takes ... The existence of such a substance ... but continues to be a subject of ... At the same time we may see the reason why ... undergoes a process of reduction ... through the agency of light this ... this transformation may ... change of its colour, and other optical ... being colourless and having ... However, the change of colour ... great number of leaves on exposure ... which is generally attributed ... might, partly at least ...

C. TIMIRIAZEFF

[illegible]

## July Meteors

... 14, 111 shooting stars were recorded ... The paths of these ... globe, enabled me to fix the ... considerable distances ...

[illegible]

... long, swift with streaks ... yellow ... July 8. ... faint, near π Herculis ... faint, near ζ Draconis ... In Cerberus ... slow, long paths ... swift and short, near α Lyræ ... near γ Lyræ ... near ο Draconis ... In Vulpecula ... bright, near ... streaks ...

... well observed by ... and 98 of the ... from his observations ... during the past ... as bright as Jupiter ... to be very accurate ... and the ... a member of the ... from a centre ... I have not included the ... shooting star with ... included by ...

... members of the August ... between 9h. 45m. ... of which were unusually ... their long, graceful ... This ... would seem ... August 10.

W. F. DENNING

## The August Meteors

... crossed Cassiopeia ... Its trail was ... of the meteor ... meteors, the ... horizon, but ... this meteor ... Palace fireworks ...

H. B. JUPP

## A Possible Windfall for Science

... action that the department ... should first examine ...

[illegible]

Electrical Phenomena in Mid Lothian

iron has hitherto been used, mass and stiffness due thereto, are required, rather than great tenacity and ductility, and there is, therefore, likely to be a simultaneous demand for castings of both steel and iron. Concurrently with steel castings, steel [illegible] have gradually been coming more and more into general use for fine and delicate work, where [illegible] is of consideration, and homogeneity and [illegible] of the very greatest importance.

Steel has [illegible] grain, and [illegible] strong in one direction [illegible] than [illegible] is eminently suitable for such work, and [illegible] superseding iron completely. The conclusion [illegible] on the subject of the employment of iron and steel in [illegible] is one in which upon full [illegible] that the laws of [illegible] apply equally [illegible] and [illegible] the long run the [illegible] peculiarities and [illegible].

The next paper [illegible] by Mr. J. Ruston, M.P. [illegible] steam navvy.

[illegible]

when excavating materials of various degrees of hardness and toughness.

Mr. John Richardson's paper on recent adaptations of the Robey semi-portable engine was an extension of a paper read in 1873. The engine is erected on a massive wrought-iron foundation plate, to which all the working parts are fixed, together with one of the drum-shaft bearings and the brackets for carrying the brake-straps and levers. The whole of the strains due to the working of the machinery are contained within the base plate, and are brought, as they should be, near to the position of greatest stability, namely, the ground line; while the boiler is set free from all mechanical strain, and is left to its legitimate purpose of making steam. A specially light engine has been designed for use in countries where there is little facility for transport, wrought iron and steel having been substituted as far as possible for cast iron, with the result of a large saving in dead weight and consequent saving in cost of transport.

A paper on private installations of electric lighting, by Mr. Ralph Neville, is interesting as descriptive of an application in which existing engine power was utilised, and modifications made in the governing of the engine for the purpose of driving a dynamo machine, in which, as is well known, the action on the engine has to be [illegible], the electric lamps acting as visible instantaneous [illegible]. The dynamo employed was a Siemens [illegible], the lamps being [illegible] 20 candle-power [illegible] make. The current generated is led [illegible] a set of switches, by which [illegible] separate circuits, the first [illegible] of the dynamo itself and the [illegible] in various parts [illegible] centres, and the electromotive [illegible] kept constant; for this purpose [illegible] the mains at the required [illegible] the governor is taken [illegible] from the terminals of the [illegible] attached to the engine [illegible] inertia that its position [illegible] very considerable variation [illegible] an electrical governor.

[illegible] governor consists of a double [illegible] vertically and wound with [illegible] works a double cone [illegible] of the cores is linked [illegible] short arm of which presses [illegible] Cornish valve that [illegible] the steam-chest. [illegible] parallel, the wire on bobbins [illegible] the main leads; and the [illegible] to the electromotive [illegible] between the mains [illegible] at the right point [illegible] by their attraction [illegible] of the solenoids [illegible] force causes an [illegible] them, whereby the core [illegible] an increased force, and [illegible] thereby acting through the [illegible] electromotive force has [illegible] normal amount. The [illegible] is exceedingly small [illegible] be best suited for electric [illegible] expansion-gear, on which the [illegible] has the disadvantage [illegible] running, the steam is cut [illegible] of the stroke that, unless the fly- [illegible] a diminution occurs in the [illegible] of the fly-wheel. In a [illegible] of coal has to be considered [illegible] would be to have an expansion gear [illegible] hand, which can be set approximately to the expansion required leaving the throttle-valve to

### FORMOSAN ETHNOLOGY

RECENT political events in the East have directed public attention in Europe, more especially in France, to the large and important island of Formosa. They have shown how scanty our knowledge really is of everything relating to an island which has been known to Europeans for about three centuries, which has been actually held by an European power for twenty years, and in which for about a quarter of a century there have been three ports opened to the trade of the world. Such knowledge as we possess is derived from the works of Dutch writers of the commencement of the seventeenth century, and from fugitive papers published, by one or two learned societies in Europe and the East, and especially by journals and [illegible] of the Far East, the names of which are hardly known beyond a limited circle of special students, some of them being extinct for years. This poverty of information regarding one of the most important islands in the world, which, moreover, [illegible] considerable portion of the trade of the [illegible] real, but to [illegible] in the way of research [illegible] present. Such information as could be obtained from the sources here indicated with regard to the ethnology of Formosa has been collected by M. Girard de Rialle, and arranged in two articles contributed to the [illegible] of the *Revue d'Anthropologie* (January and [illegible]). The value of these articles, besides collecting [illegible] information not readily accessible [illegible] at all except in the most comprehensive [illegible] libraries, is that they contain a sound [illegible] theory on one of the perplexing problems of modern ethnology, viz. the origin of certain little known tribes inhabiting for the most part the recesses of the chain of mountains running from north to south, [illegible] Formosa, and generally known as the Formosan aborigines.

Broadly, the population of Formosa may be divided into three classes: the immigrants from China, those natives who have submitted to Chinese rule, and the independent tribes. It would be useless to attempt to discuss which of the estimates of the number of the population is most likely to be correct, for they vary between [illegible] and [illegible] souls. The Chinese immigrants are [illegible] to Formosa. They come mostly from Amoy and from the neighbouring province of Fokien. They [illegible] a large number of Hakkas, a people who are themselves the subject of an interesting ethnological question, which, however, we cannot discuss here beyond saying that [illegible] representatives of pure [illegible] Chinese [illegible] of the valley of the Yellow River [illegible] history, while others speak of them as of Malay origin. The division of the aborigines into subjugated and free is obviously of no value for ethnological purposes, although it is convenient in certain cases. The point which most perplexes the [illegible] of the question [illegible] at once. The aborigines have undoubtedly been head hunters, like the Dyaks of Borneo and the Igorrotes of Luzon, but there is no modern authority in support of the charge of cannibalism made against them by [illegible] writers, especially by Montanus [illegible]. M. de Rialle thinks that the allegation might have been correct at an earlier period, inasmuch as the practice is known among the Battaks of Sumatra, as well as in Borneo and the Celebes. But no traces of it have appeared recently in Formosa. Another difficulty has been raised by the statement of the early Dutch writers that there is a pure black race in Formosa, of great stature, inhabiting the mountains and speaking a different language to the rest of the inhabitants. This would apparently refer to Papuans, and M. de Rialle asks whether perhaps here, as in the Philippines, we may not perceive the existence of an old autochthonous race, or at any rate one so ancient that it may well be considered such. There would be nothing surprising in this, for in the Indian Archipelago an ethnic substratum of Papuans and Negritos has been discovered. But the statement has not been confirmed by modern explorers, some of whom have travelled through the island in order to settle the question. Neither the Chinese nor the natives have ever heard of this black race, and it is possible that a very dark tribe in the south were so called by the Dutch. But M. Paul Hus, in his "Promenades Ethnographiques," thinks that when the Malays invaded Formosa it is not impossible they found a black race there, which they exterminated or absorbed, and other ethnologists have a theory that there was once an epoch of pure Negritos in the island. However this may be, there is now no trace of the [illegible] black race of the Dutch writers of two hundred years ago.

The Chinese divide the aborigines of Formosa into three classes: the *Pepo-hoan*, or "barbarians of the plains," the [illegible], or "[illegible] barbarians," and the *Chin-hoan*, or "green barbarians." The island, as already noticed, is divided into two unequal parts by a lofty range of mountains. On the western side, which is the nearer to China, and [illegible] that peopled by Chinese immigrants, the country consists for the most part of large and fertile plains. The aborigines were gradually driven back from the coast by the immigration from the mainland, and pressed towards the mountains. In [illegible] a considerable number submitted peacefully to the Chinese authorities and became civilised, or rather [illegible]. These are the Pepo-hoan of the Chinese. They live on the plains and smaller hills bordering the mountains. Here they form large villages surrounded by [illegible] sub-tropical vegetation. In some places near the Chinese settlements they have adopted the [illegible] and habits of the conquerors, but they have preserved their ancient culture. They are fetish-worshippers. One traveller found in one of their houses [illegible] the skull of a deer adorned [illegible]. This he was told was [illegible], which was by its side, was [illegible] like a cradle. A [illegible] appeared to be the only offering [illegible] at the moment. The women [illegible]. Dancing appears to be [illegible] with religious ideas and rites, and [illegible] they appear similar [illegible]. M. Paul [illegible] of these [illegible], states that [illegible] presented the closest [illegible]. In spite of the name [illegible] by the Chinese, they are no [illegible] of the Celestial Empire; they are for the most part devoted to agriculture. In some places they are intermediaries between the independent [illegible] and the Chinese, conveying the forest products of the former to the [illegible] and obtaining Chinese goods in exchange. Their great [illegible] has been noticed by all Europeans who have seen them. The hair is [illegible] the men by being oiled and rolled round the head, [illegible] covered with a large turban of [illegible]. The women twist their hair into a large [illegible] with a red ribbon. This is wound round the head and appears above the forehead like a kind of natural diadem. The Pepo-hoan, who have been least influenced by the Chinese, and who have preserved their ancient customs and dress, inhabit [illegible] in the centre of the southern half of Formosa, especially in the valley of the Lakoli River, which, flowing almost due south, enters the sea at the harbour of Tan Kang. The Sek-hoan, the second of the Chinese divisions of the aborigines, inhabit part of the centre of the northern half of the island, as the

[illegible]

Pepo-hoan do the southern half. The Sek-hoan settlements are mainly in the neighbourhood of Chang-hua, slightly to the north of the 24th parallel, and in the hilly districts dividing the mountains from the plains in the west. They appear to have fully accepted the Chinese yoke, and even the village headmen are appointed by the Chinese authorities. These tribes are absolutely sedentary, and devote themselves wholly to the cultivation of rice, sugar-cane, and indigo, which they have learnt from the Chinese. They have adopted the dress and habits of their masters; they shave the top of the head and wear long queues. The women also dress like the Chinese, but they do not deform the feet. The type of these Sek-hoan appeared quite distinct from that of other Formosans to two travellers, Mr. Bullock and M. Ibis. The former describes them as tall, but feeble, with a comparatively clear skin, large bright eyes, the mouth extremely large, with thick lips, a projecting upper jaw, and teeth long and prominent. The lower part of the face is as ugly as the upper part is prepossessing. But although they bear little resemblance to the aborigines, they have still less to the Chinese and Loochooans, the only peoples amongst whom we should seek for their origin, if they are of different blood from the other Formosans. M. Ibis states that the Sek-hoan present a contrast to the Malay type in the case of the males, although a resemblance may be found among the females. He attributes their anthropological peculiarities to mixture with the Dutch two and a half centuries ago. He states that there are still old Dutch books and documents amongst them, and that the method of cultivating tobacco (which they call *tamako*, and not by a Chinese name) is similar to that of the Batavian colonies. In the extreme north, around Tamsui and Keelung, there are also groups of Sek-hoan. Driven from the coast by the Chinese, and prevented by the savage tribes in the mountains from penetrating into the interior, these have been almost exterminated. The remnants live in scattered communities among the sandy downs or in the rocky islets off the coast. M. Ibis visited one of their villages on a small island in Keelung Bay, where he found them in great destitution, but bearing evident resemblances to the Sek-hoan further south. He also noticed the Caucasian features, which they got from the connection between their ancestors and the Dutch and Spaniards of the seventeenth century. Around Tamsui the Sek-hoan are rapidly becoming extinct; absorption into the Chinese, and opium, alcohol, and smallpox will soon do their work. Many of their most prominent features are Malay, but the form of the skull is quite different, if we may rely on two specimens brought to Europe in 1868. Dr. Schetelig found the cephalic index of the living males to average 77, of the females 76; but, on the other hand, there were the Malay physiognomy and the language of these Sek-hoan to render difficult their ethnological classification. On his return to London, however, Dr. Schetelig saw the collection of Polynesian and New Zealand skulls in the Museum of the College of Surgeons, and he found amongst these remarkable analogies with the skulls collected by him in the north of Formosa. On the north-east coast, at Suwo Bay and the neighbourhood, there are other subjugated tribes called Kabaran, Sui-hoan, and the like. They are all of the Malay type, and appear to be rapidly disappearing through contact with the Chinese.

The whole mountainous region from the north to the extreme south, forming nearly the eastern half of Formosa, is inhabited by aborigines who have accepted neither the yoke nor civilisation of the Chinese. These are called the *Chin-hoan*, or "green, unripe barbarians," in contradistinction to the *Sek-hoan*, or "ripe barbarians." These live in a state of perpetual war with the Chinese, and it is alleged that the latter brought tigers to Formosa and set them loose in order that they should prey on their enemies; the latter, however, succeeded in exterminating them. They are determined head-hunters, the young warrior commencing his career by securing a certain number of Chinese heads. Under these circumstances it is not surprising that our knowledge of these tribes should be exceedingly limited. A Spanish priest visited some of them in 1875-6, and they have been occasionally visited by Europeans who have touched on the east coast. They are represented as like the Malays, but much fairer in colour than even the Chinese. More, however, is known of the tribes in the extreme south than of those on the east coast or in the mountains. They have been heard of in Europe chiefly by their various murders of shipwrecked seamen.

The various tribes are known as Kalis, Bhotans, Koaluts, &c., and their districts have been frequently visited by European officials desirous of obtaining from them some assurance of better treatment for mariners thrown on their coast. The late Mr. Swinhoe, who visited them for this purpose, states that some of them approached the Mongol type, while in others there was an enormous development of the lower jaw. After new observations he described them as resembling the Tagals of Luzon. In 1874 the massacre of the crew of a Loochooan junk by the tribes led to a powerful Japanese expedition being despatched for their chastisement. The Kalis and Bhotans suffered so severely that their subsequent subjugation by the Chinese was rendered easy, and the Chinese Customs established a station and lighthouse on the south cape. An account of the expedition despatched to arrange this latter enterprise was read before the Royal Geographical Society in January last by Mr. Beazeley, the engineer employed in the work. Soon after the Japanese expedition M. Paul Ibis visited the south of Formosa, and has described nine separate tribes differing in linguistic and anthropological details. He thinks their dialects are connected with the Tagal language; seven of the nine had little physical resemblance to the members of the other two. Several other tribes have been described by other travellers, and in most cases they are marked by important peculiarities. It would be impossible, even if it were likely to serve any useful purpose, to go into details of the habits of each of these. All that is necessary for our present purpose is to note that there certainly are numerous distinct tribes amongst these independent aborigines, and that in describing them various travellers refer constantly to their resemblance to Malays, Igorrotos, Tagals, Soolooans, Dyaks, and other peoples of the Malay Archipelago. The reader will therefore be prepared for M. de Rialle's conclusion that these aborigines belong to the great ethnic family known as Malayo-Polynesian. MM. Quatrefages and Hamy speak of them in the "Crania Ethnica" as "analogous to the Acheenese, Lampongs, and Eastern Sundanis. They are Indonesians, closely allied to Polynesians." But there are ancient mixtures with other anthropological elements. Whether these took place in regions from which the ancient immigrants came, or in Formosa itself, will probably never be known positively. The peopling of Formosa is probably due to successive invasions, doubtless far removed from each other in point of time, by Malayo-Polynesians, and this, M. de Rialle believes, is sufficiently proved by the great differences which, notwithstanding their common anthropological origin, have been observed by travellers amongst the various mountain tribes in the island. Whether a comparative study of the Formosan dialects with those of the Philippines, Borneo, the Celebes and other parts of the Malay Archipelago, will carry the solution of the problem any farther than this remains to be seen; but there appears no immediate prospect of any student being able to study the independent tribes of Formosa. They are as remote from us, for any purpose of accurate investigation, as ever they were, and far more remote than they were from the Dutch and Spaniards nearly three centuries ago.

## THE AURORA

### II

WE next come to the 11-year period. On this the following pertinent remarks are made:

"It will be perfectly clear that it is chiefly observations from the Temperate Zone which have constituted the material for determining the eleven-year period. But as regards the Polar regions, it has been assumed that either the Aurora Borealis also follows the same laws in these parts or that it appears with the same force and same manner all the year round. Neither of these alternatives seem, however, to be right, as a series of observations prosecuted with great care during fifteen years at Godthaab, in Greenland, have brought me to the somewhat remarkable conclusion that, as regards the varying frequency of the Aurora Borealis at Godthaab, [illegible]

"These researches, which were effected by Mr. S. Kleinschmidt, extend over a period from August [illegible] to May 18[illegible]. The number of days [illegible] the year, reckoned from August to May, were: [illegible]

[illegible]

"This series [illegible]

[illegible]

"If the two series be [illegible]

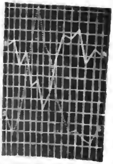
"The few [illegible] other Polar regions [illegible]

"As the greater part [illegible] made in the [illegible]

"If we [illegible]

Godthaab, the auroræ which fall in the zenith of the place or further north, are not only absolutely, but also relatively, more frequent than at the periods of minimum. And what deduction may be drawn from this? The deduction that the auroral zone in the course of the eleven-year period makes a movement too, of such a nature that it lies further north when the sun-spots are in their minimum than in their maximum period.

"If this result be compared with what I have already propounded as to the eleven-year period in the Arctic regions, the interesting explanation will be obtained of the phenomenon, that this period in Greenland and similarly situated places shows a reverse course to that in more southern regions. The auroral maximum, occurring in the temperate regions simultaneously with the sun-spot maximum, is due to the auroral zone being then in its southernmost position, which again causes an auroral minimum in the polar regions, and, in a reverse manner, the auroral zone has its northernmost position when [illegible] [illegible] the minimum, which then causes [illegible] the temperate regions and a [illegible] Pole."



[illegible]

[illegible] that there can b[illegible] of the auroral zon[illegible]

[illegible] thrown by M[illegible] appearances are in th[illegible] auroral striæ in differen[illegible]

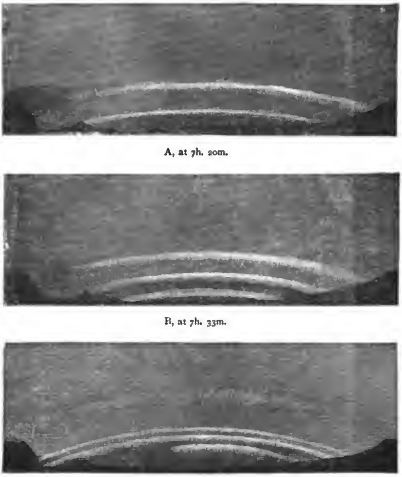
[illegible] autumn at Koutokæin[illegible] to the understand[illegible] the changes [illegible] when altering [illegible] through th[illegible] by its appearance [illegible] and now in th[illegible] of studying th[illegible] as it changed it[illegible]

[illegible] on that the grea[illegible] certainly be re[illegible] in most instances the [illegible] across the earth [illegible] west, which zones are [illegible] sheets of luminous [illegible] their direction being parallel with the inclination needle. The luminous matter in these sheets is either even, diffuse, or divided into streamers.

"Everything now depends on the position of the observer in relation to such a zone in order that it may appear in one form or the other. If he be very far from the aurora he will see an arc, diffuse or radiating, according to the nature of the luminous matter. If he approaches he will most probably see several distinct arcs, the phenomenon gathering more force and the colours more life; and when still nearer, the aurora will appear as a band, and, if the luminous matter be radiating and passes the magnetic zenith of the observer, he will behold the auroral corona."

He thus holds that a "band" is a near arc occupying a higher position in the sky:—

"The auroral band is oftenest seen in those parts of the globe which are considered to be the true home of the Aurora Borealis, but seldom, or hardly ever, in southern latitudes. What is chiefly characteristic of the band in opposition to the arc, although no sharp line of distinction can be drawn here either, is its great height above the horizon, but at what elevation it ceases to be band and becomes arc is naturally an arbitrary determination. The band, as well as the arc, may consist of equi-luminous matter, of streamers, and of so-called luminous clouds, and it is, to a higher degree than is the case with the arc, subject to the most violent changes of position, form, and motion. Particularly when the band consists of streamers it displays the richest variations and greatest beauty, the folds of the streaming drapery, the prismatic play of colour, and the light-waves, which with marvellous rapidity course through the graceful undulating rays, forming a spectacle of light, colour, and form which makes this variety of the Aurora Borealis the most charming of all.



A, at 7h. 20m.

B, at 7h. 33m.

C, at 8h. 10m.

FIG. 5.—Phases of an auroral arc, December 1, 1878.

"The perspective fundamental form of the arc, and also the band, may, in my opinion, be explained by the aurora forming one or several rings, or fragments of such, which, with the magnetic pole as centre, or, more correctly, with a point in the magnetic axis of the earth—viz. the straight line between the two magnetic poles—lie at a certain height above the earth's surface. On account of the great circumference of the earth, in proportion to the height of the aurora, only a small portion of such a ring would be visible at one time, and each observer only see his own portion, the situation of which in relation to *his* horizon and the zenith will depend on *his* position in relation to the auroral ring."

The auroral streamers are closely associated both with arcs and bands, an arc or band composed of streamers often forming the basis for a colonnade of streamers.

Before we proceed to the consideration of the corona, the following extracts concerning streamers and their apparent motions will be read with interest:—

"The streamers embrace a number of varieties, which have only one peculiarity in common—viz. that the direction is very nearly vertical, and that the length is always greater than the width. The length differs greatly, from 2° and 3° to 30° and 40° or more. The width is very difficult to estimate, on account of the constant motion; a single streamer thus may form only a slender thread of light, while others may have a width of from 10′ to 1°, or more. Short streamers form often, as I have mentioned above, bands or arcs. The long streamers gather generally in bunches, which may either remain isolated, or particularly when the aurora has previously formed an arc, stand parallel, in such a manner that the lower, intensest, ends nearly follow the track of the former arc. Bunches of streamers, standing high in the sky, are often fan-shaped, the broadest part pointing downwards. The intensest streamers have very clearly defined edges, but from these there are all sorts of variations down to the streak of light hardly visible. At the side of, and between very intense and defined streamers, the sky seems, by the contrast, unusually dark, and this may, perhaps, explain the *black* streamers which some observers claim to have seen.

FIG. 6.—Aurora (Koutokæino).

FIG. 7.—Streamers (Koutokæino).

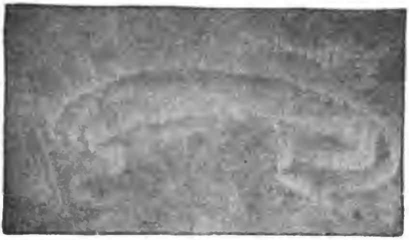


FIG. 8.—Bands and streamers (Koutokæino).

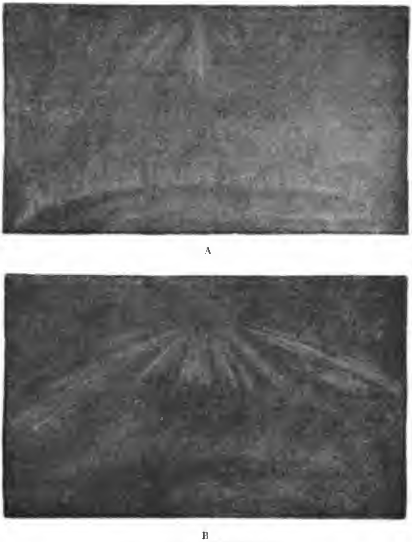
"The points of the streamers are usually faint and with no sharp line of demarcation. The stars shine through the streamers as through all other forms of the aurora, and it may, indeed, be a matter of doubt whether the strength of light of the aurora is ever great enough to outshine a bright star." . . .

"The motion of the streamers is twofold. First, longitudinally, as they strike upwards or downwards; and secondly, laterally, as they travel parallel either to the left or right. Sometimes this motion is slow, sometimes very quick, and particularly in the latter case the observer obtains the impression that the colonnade of streamers is furrowed transversely by waves of energy following in rapid succession, under the influence of which the streamers momentarily flare up. If this be the case, or the streamers really move, it is impossible to tell.

"The longitudinal course of the streamers is not apparently only, but in reality, very nearly vertical, as several facts prove that they point in the same direction as the magnetic inclination needle." . . . "In regions near the magnetic pole, where the magnetic inclination is greater, the streamers stand more perpendicularly than in more southern latitudes, where they form a smaller angle with the surface of the earth.

"Some students, as, for instance, Baron Nordenskjöld, have advanced the theory that the streamers do not occupy this position, but lie more parallel with the earth; and, indeed, when observing an apparently perpendicular streamer in the north, it may in reality form any angle with the horizon, and still seem to the eye to stand perpendicular. But from various circumstances it is clear that the direction of the streamers is, as I have stated above—viz. parallel with the inclination needle. This is, in fact, demonstrated not only by the streamers high in the sky, which form the upper part of the corona, but also by those which, under intense auroræ, stand either in the east or west, and which are then seen '*from the side*,' so to speak, *i.e.* they stand very nearly perpendicularly, as indicated to all appearances by the streamers seen to the north '*in front*.'"

The auroral *corona*, the grandest sight of all, is found at the instant a band or broken band forming a colonnade



A

B

Fig. 9.—Coronas (Koutokæino).

of streamers reaches the magnetic zenith in its progress from the north:—

"Quick as lightning streamers break forth at the same moment on the southern side of the magnetic zenith, and as the aurora travels further and further southwards, the corona becomes more and more complete. In northern regions, where the aurora frequently appears high in the sky, in a northerly or southerly direction, there is often an opportunity of seeing this form of the phenomenon, when a band of streamers passes the magnetic zenith in its course north or southwards. It is, however, not always that the aurora's passing of the zenith has the effect of producing the corona; it is seldom the case when a band constituted of diffuse luminous matter passes this point. It is, in fact, the streamers which create the corona." . . .

"If it be borne in mind that the course of the auroral streamers is identical with that of the magnetic inclination needle, it is easy to perceive the origin of the ordinary radiating aurora as well as the corona." . . .

"This form of the Aurora Borealis, which generally indicates, at all events in southern latitudes, the culmination of the aurora as regards splendour, colour, and development, is produced by the streamers shooting from every part of the sky towards a common point—viz. the magnetic zenith. With this point as centre they seem to radiate in every direction; some are very long, others short, while some form rays or bands one above the other. The heaven thereby assumes the appearance of a huge cupola, or tent of fire. In reality the streamers are all parallel; their appearance of radiating in all directions from a central point with various angles being due to perspective [illegible]—[illegible] by the points of the streamers being further distant than the bases. It is the same perspective peculiarity which causes the lamps in a street or the trees in an avenue to appear to meet in the distance.

"The centre of the corona is sometimes dark—that is to say, the sky is seen between the streamers, at other times the central part is filled with luminous matter.

"It is not only the streamers which contribute to form the corona; on the contrary, all the forms of the aurora lend their beauty to produce this magnificent display. If to this is added that the Aurora Borealis in such moments develops its greatest strength, richest colour, and most intense light, it will be understood that the corona is that form of the phenomenon which possesses the greatest magnificence and most striking beauty."

With regard to the height of the aurora, a preliminary examination of the observations made in the [illegible] gives from [illegible] miles, an average of [illegible] measurements [illegible] miles [illegible] kilometres.

From this long article on aurora, the reader must not think that [illegible] is exclusively occupied with them. His two volumes are admirable examples of what books of travel should be, and [illegible] falls to the lot of few travellers to have such an interesting region to explore, or to have such an important piece of scientific work to accomplish.

## THE BRITISH ASSOCIATION

OUR readers are aware that at the approaching meeting of the British Association it has been arranged to have [illegible] in Section A [illegible] kinetic theory of gases [illegible] Prof. [illegible] kinetic theory [illegible] the [illegible] College, Sheffield.

*Difficulties connected with the Dynamical Theory of Gases.*

The dynamical theory of gases appears at first sight to furnish a very complete explanation of all the properties of gases, both physical and chemical. When, however, we come to details, difficulties and apparent [illegible]

[illegible]

consistent with the hypothesis that these molecules consist of two smooth, undeformable spheres at a constant distance from each other, the five degrees of freedom being three of translation and two of rotation about two axes, any two at right angles to each other and at right angles to the axis of the molecule, that is, the line joining the centres of the two atoms. But here also we have spectra, and in addition the phenomena of dissociation lead to a belief that the firmness of the union of the two atoms diminishes as temperature rises, and it is difficult to reconcile this with a constant distance of the two atoms from one another in the molecule. Any variation in this distance would be a new degree of freedom in addition to the five allowed by the theory.

All attempts to reconcile chemical action and chemical [illegible] with dynamical conceptions seem to require the assumption of vibrations of the atoms in the molecule, under the influence of forces depending on the distances of the atoms from each other, and perhaps in addition to these, vibrations of the atoms as parts of the molecule, [illegible] of the atoms themselves. In molecules, even of a comparatively simple kind, such considerations imply many degrees of freedom, certainly far more than the dynamical theory of gases as usually understood would admit.

2. *Difficulties connected with the doctrine that energy [illegible] among the molecules according [illegible] law of probability.*

This implies that in a gas at any temperature there are molecules in the condition as to energy which is the average condition of the gas at any other temperature. Thus, for instance, at the ordinary atmospheric temperature there are molecules in the condition which is the average [illegible] heat.

[illegible] consistent with what is usually regarded [illegible] that there are limiting conditions of temperature and pressure, on the one side of which certain chemical changes occur, while they do not occur at all on the other side. Thus at ordinary atmospheric temperatures and pressures, hydrogen and oxygen show no tendency to [illegible]. At a red heat they combine almost completely. At ordinary temperatures phosphorus combines slowly with oxygen [illegible] the pressure of the oxygen is below a certain limit dependent on the temperature, but apparently not at all if the pressure of the oxygen is above that limit. [illegible] might be mentioned, but these may [illegible]. It is difficult to understand the [illegible] definite sharp limits, if the energy is [illegible] the molecules according to any [illegible] the rate of chemical [illegible] to diminish, but not to become [illegible].

I have brought forward these instances of apparent [illegible] the conclusions of the dynamical theory [illegible] and observed facts in the hope that [illegible]. This may conceivably be [illegible] showing that the facts have [illegible], or that the conclusions [illegible] from the theory.

## NOTES

[illegible] holds its summer meeting in [illegible] excursions [illegible] Forth Bridge Works. The [illegible] On the iron and [illegible] Glasgow; on the rise [illegible], by Mr. James Riley, [illegible] on the present position and [illegible] ammonia from [illegible] furnaces, N.B.; [illegible] of the South Chicago [illegible] furnaces, by Mr. F. W. Gordon, Philadelphia, and Mr.

has had frequent opportunity of noting the phenomena of echoes by means of steam-whistles, guns, fireworks, &c., and has received distinct echoes from various surfaces, some of which were not very promising. The sails of vessels and an approaching tug-boat, referred to by Prof. Graham Bell, are additional sources of sound-reflection, but Mr. Lawton thinks that the echo in the case of the latter may have come from some other surface than the bows of the boat, which, unless very bluff or square, would have a tendency to reflect the sound at right angles. If it be true that in Atlantic voyages the sound of the steam-whistle is echoed back by the fog itself, then, Mr. Lawton thinks, the echo from so large a body as the fog would be much sharper, more abrupt, and easily distinguished from the [illegible] by the fog, which, from its varying density and elasticity, would seem to [illegible]. [illegible]

[illegible]

The Saxon [illegible] company [illegible] each of the normal value of [illegible] the [illegible] London [illegible] the [illegible] and [illegible] to people [illegible] attending [illegible] the United Kingdom. The [illegible] agreed to [illegible] from 585*l.* to 900*l.*

Dr. Trimen, director of the Royal Botanical Gardens of Ceylon, has just published a systematic catalogue of the flowering plants and ferns indigenous to or growing in Ceylon. The list gives the botanical, Singhalese, and Tamil names, and is a complete index to Thwaites's "Enumeratio Plantarum Zeylaniæ," but it differs from the latter work in the sequence of the families or natural orders. In addition to the flowering plants and ferns, Dr. Trimen has added five natural orders—viz. Rhizocarpeæ, Lycopodiaceæ, Isoeteæ, Selaginellaceæ, and Characeæ. The catalogue includes 156 natural orders, 1071 genera, and 3445 regular species, with 405 varieties, some of which may prove to be distinct species. The catalogue is issued as a number of the Journal of the Ceylon Branch of the Royal Asiatic Society.

The weather in Northern Norway in June has been very remarkable, and we must go back to the year 1869 to find anything similar. The weather, early in the month, was very cold, [illegible] while on the 11th the temperature fell [illegible] a temperature which has not before been [illegible] at all events not since 1867. [illegible] the temperature in Christiania [illegible] the 28th, 79°.3 F. [illegible]

[illegible]

[illegible] Exhibition [illegible] of these method of [illegible] atmospheric air by the [illegible] A description of the [illegible] the English [illegible] The [illegible] is now very old [illegible] the baryta [illegible] due to the [illegible] the air. In this [illegible] water by caustic soda is [illegible] a temperature [illegible] is regulated by a pyrometer [illegible] the supply of gas to the furnace. Under [illegible] the oxygen of the air is absorbed by the baryta, peroxide of barium being formed. The nitrogen, which appears to be very pure, is collected separately for use in the production of ammonia. On heating the peroxide

In the *Journal des Savans*, 1672, the new star is said to have followed β Cygni on the meridian by [illegible] 44s., which would give its right ascension in precise agreement with the [illegible] observations of the small star No. 1814.

THE CINCINNATI OBSERVATORY.—The eighth part of the publications of this Observatory has been circulated, and contains the observations of comets made in the year 1883. It is noteworthy as presenting a pretty complete report on the phenomena of Pons' periodical comet of 1812 at its reappearance; the features of the tail were particularly studied, and the discussion of the observations, based upon the theory of Dr. Bredichin, has been found to add confirmation to that theory: they are best satisfied with a value of [illegible] less than 2·5, corresponding to the second type; and this value nearly accords with that inferred by Dr. Bredichin himself in his memoir, "Les synchrones [illegible]" [illegible] 1883-84'. [illegible] a large number of observations by different observers. Thirteen [illegible] form part of the publication, affording highly interesting details on the physical aspect of the comet from October 30, 1883, to January 26, 1884. The drawings were partly made with the 11-inch refractor, and partly with the [illegible], and in [illegible]. [illegible] January at the [illegible] was equal in length [illegible].

The Cincinnati Observatory is now under the direction of Mr. J. G. Porter. The observations printed in the publication last [illegible] were made by Mr. H. C. Wilson while in temporary charge.

TEMPEL'S COMET, 1867 II.—Dr. Schur searched for the comet [illegible] with the great refractor at [illegible] many evenings in March and April. M. [illegible] showed that the chance of detecting the comet [illegible] perihelion was but small. The next return, in the spring of 1892, will take place under much more advantageous conditions.

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, AUGUST 16-22

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on August 16*

Sun rises, 4h. [illegible]; souths, 12h. 4m. [illegible]; sets, [illegible]; decl. on meridian, 13° 37′ N.: Sidereal Time at Sunset, [illegible]

Moon (at First Quarter on August 17) rises, 12h. [illegible]; souths, [illegible]; sets, 22h. [illegible]; decl. on meridian, 12° 21′ [illegible]

| Planet | Rises | Souths | Sets | Decl. on meridian |
|---|---|---|---|---|
| | h. m. | h. m. | h. m. | ° ′ |
| Mercury | 7 46 | 13 [illegible] | 19 47 | 0 [illegible] N. |
| Venus | 7 34 | 13 [illegible] | [illegible] | 4 [illegible] N. |
| Mars | 0 49 | [illegible] | 17 22 | [illegible] N. |
| Jupiter | 6 27 | 13 12 | 19 57 | 8 [illegible] N. |
| Saturn | 0 32 | 8 41 | [illegible] | 22 [illegible] N. |

*Occultations of Stars by the Moon*

| August | Star | Mag. | Disap. | Reap. | [illegible] |
|---|---|---|---|---|---|
| | | | h. m. | h. m. | ° ° |
| 20 | B.A.C. 6252 | 6 | 23 [illegible] | 0 54* | 165 [illegible] |
| 21 | B.A.C. 6312 | 6 | [illegible] | 1 15 | 105 [illegible] |
| 22 | [illegible] Sagittarii | 6 | 0 15 | 0 31 | 157 [illegible] |

* [illegible]

The Occultations of Stars are such as are visible at Greenwich.

| August | h. | |
|---|---|---|
| 19 | 11 | Mercury stationary |

## GEOGRAPHICAL NOTES

THE Dutch journals contain an account of the Dutch scientific expedition, in March and April last, to explore the upper course of the Surinam River. The members are well satisfied with the result. Their success was in great part due to the rainy season not setting in till towards the end of the journey. [illegible] were thus enabled to examine the rocks along the [illegible] which in periods of high water are hidden from view. Their first station was Phaedra on the left bank of the Surinam; the next the Tafra Kasha which lie in the middle of the stream. Here they were forced to leave their steamer and continue in a fishing-boat. At Berg-en-dal they took the height of the neighbouring Blue Mountain which they ascended, and from which they had a view of the various mountain chains of Surinam. In general the mountains of this region are covered with trees, but the Blue Mountain is quite bare. Near the mouth of the Sara creek the travellers first met some villages of the bush negroes. At Toledo, a negro village, they came to the end of their steamer journey. On the return they visited gold fields near [illegible], where they made themselves acquainted with the native methods of washing the gold. From a geological point of view the expedition was fortunate; but the rapid travelling and short stoppages prevented much being done by the zoologist. Professor Martin has made a collection of the rocks in various parts of the Surinam.

WRITING from Ciudad Bolivar in May, M. Chaffanjon continues his report to the Paris Geographical Society (the first part of which we have already referred to) on his exploration of the [illegible]. Since the date of his last letter he made a journey [illegible] the Aragua tribe up the Caura River to its [illegible]. He passed freely through the territory of various tribes, such as the [illegible] and others who are notorious for their ferocity, and he obtained from their chiefs a mass of curious information respecting their manners and religious beliefs. [illegible] complete skeleton, he was surprised [illegible] and his followers [illegible] accompanied only by [illegible] and continued his journey, [illegible] in the time. He was also able to [illegible] Mapayes tribes.

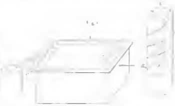
[illegible] of the Royal Geographical Society of [illegible] (1885) [illegible] contains [illegible] by the secretary on the [illegible] explorations made in the basin [illegible] between 1883 and 1877, the [illegible] of the International Association [illegible] State, and finally a sketch [illegible] notes on four months [illegible] M. [illegible] contributes a general [illegible], trade, &c., of [illegible]

[illegible] zoologist and surgeon [illegible] expedition to New Guinea, [illegible] The main objects of the expedition [illegible] the geographical [illegible] and the nature of its fauna, flora, [illegible] to make if possible [illegible]

[illegible] of the Geographical Society of [illegible] M. [illegible] read a paper on geographical [illegible] the necessity of [illegible] mainly of the creation [illegible]. His remarks [illegible] special reference to Brazil [illegible] the appointment of a commission [illegible]. Should there be a [illegible], a nomenclature [illegible] the repetition of the same [illegible] by substituting other [illegible] geographical nomenclature [illegible] geographical names in such a way [illegible] uniform? (3) Assuming [illegible] in the alternative, how [illegible]. The questions were [illegible]

The [illegible] of *Petermann's Mittheilungen* contains a [illegible] of Africa, with some observations [illegible] geography, by Prof. Ratzel [illegible] map of Africa. In one part of the [illegible] according to the prevailing occupations [illegible], agriculture with cattle-breeding, [illegible] is coloured according [illegible], Independent Negroes, [illegible] of the Thuringer [illegible] the number is that by Dr. [illegible] North-Western [illegible] Geographical Sketch of Talysch [illegible] which was originally written for [illegible] by the Grand Duke Nicholas.

THE last number of the *Mittheilungen* of the Geographical Society of [illegible] contains [illegible] by Dr. Le Monnier with



[illegible] William T. [illegible], 23, mechanical [illegible], Glasgow, and John [illegible], 22, [illegible] [illegible]; Ernest K. [illegible], 23, engineer, [illegible]; [illegible], 21, engine fitter, Paisley, 1501.; Arthur J. [illegible], 20, engineer apprentice, Preston, [illegible]; [illegible] McN[illegible], 22, [illegible], Birmingham, 100l.; George W. [illegible], 24, fitter, [illegible]; [illegible]; Henry C. [illegible], 23, engineer and millwright, [illegible]; Robert Smith, 22, engineer, [illegible]; [illegible] W. Nash, 21, engineer, [illegible]; [illegible], 19, engineer [illegible]; Arthur J. [illegible], mechanical engineer, Nottingham, 100l.; [illegible] [illegible]

## SCIENTIFIC SERIALS

[illegible]

[illegible] On the sensitiveness of the eye to colours of a low degree of [illegible], by [illegible] Nichols.—A study of thermometers [illegible] to measure temperatures from 100° to 300° C., by H. T. Shannon.—Notice of a new Limuloid crustacean from the Devonian formations of Erie County, Pennsylvania, by Henry Shaler Williams. This specimen, provisionally identified with Prestwichia, would appear to throw back the range of that group to an earlier period than hitherto reported. The [illegible] Prestwichia occurs in the Carboniferous [illegible] and artificial basic [illegible], by H. L. Wells and S. L. Penfield. The [illegible] under the name of Gerhardtite was [illegible] by Prof. Geo. J. Brush, who [illegible] copper minerals from the United Verde [illegible], Arizona. Its specific gravity is 3.426; [illegible] dark green; streak, light green; [illegible].—On the occurrence of [illegible] in the Yellowstone National Park, by [illegible].—The genealogy and age of [illegible] in the [illegible] Tertiary, Part 2. [illegible], by Dr. Otto Meyer.—[illegible] Welsh Paradoxides [illegible], by Geo. F. Matthew. This largest and [illegible] of Paradoxides occurring in the [illegible] was first discovered about twenty [illegible] St. David's, Wales, and [illegible]. But its presence has only [illegible], where specimens of large [illegible] in the Cambrian slate at [illegible], Newfoundland.

[illegible] Society of Washington, vol. [illegible] of the officers of the Society, [illegible] by the President (Mr. James [illegible]) [illegible], physical and [illegible] of papers by Mr. W. H. [illegible] knowledge of [illegible]; by Mr. [illegible] of the High Sierra [illegible] of North Carolina, [illegible] economic entomology [illegible] economy of nature, and [illegible] agriculture [illegible] the eyes of animals [illegible] light [illegible] Mr. Russell, [illegible] Mr. Gilbert, [illegible] Mr. Bates, [illegible] bibliography of North [illegible] in a paper [illegible] animals and plants [illegible] Indians [illegible] animals and plants [illegible] New Mexico [illegible] Mr. Hall, on the [illegible] satellite [illegible]

[illegible] Belgique, May.—M. Ch. [illegible] on the characters of the [illegible] luminous intensity of the [illegible] in the action of magnetism [illegible]

SOCIETIES AND ACADEMIES

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probably to the Pons-Brooks (?) comet than to Kreutz (?). The longitude (295°) of the ascending nodes nearly coincided with that of the earth on June 1, when the phenomenon again began to acquire great intensity. [illegible]

[illegible]

BERLIN

Physical Society, June 26.—Dr. König presented a new apparatus for the measurement of the modulus of elasticity, [illegible]

[illegible]

observed at each side the change in situation of each mirror, a change which occurred in consequence of the flexion under the loading in the middle, and which produced on both sides an opposite displacement of the scale. The sinking of the bar on the edges, and even a slanting position of the whole bar exercised no influence in these measurements. The apparatus suggested by Prof. von Helmholtz developed this principle still further. It had two perpendicular mirrors with the reflecting surface directed inwards at the two ends of the bar [illegible] a scale, on the other side [illegible] The image of the scale fell on the opposite mirror, [illegible] into the telescope. [illegible] flexion occurred, then the image in the telescope [illegible] to the extent [illegible]

[illegible]

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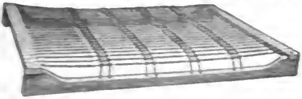

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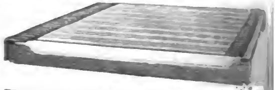

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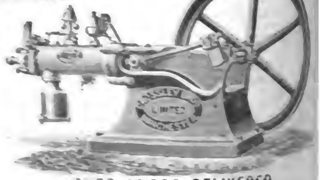

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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

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MACMILLAN & CO., London.

THURSDAY, AUGUST 20, 1885

## PROFESSOR STOKES ON LIGHT

*Burnett Lectures, Second Course. On Light as a Means of Investigation.* By G. G. Stokes. (London: Macmillan and Co., 1885.)

THE interest raised by the first series of these lectures is fully sustained by this second instalment, though the subject-matter is of a very different order. *Then*, the main question was the nature of light itself; *now*, we are led to deal chiefly with the uses of light as an instrument for indirect exploration. It is one of the most amazing results of modern science that the nature of mechanisms, too minute or too distant to be studied directly with the help of the microscope or the telescope, can be thus, in part at least, revealed to reason. This depends on the fact that a ray of light, like a human being, bears about with it indications alike of its origin and of its history; and can be made to tell whence it sprang and through what vicissitudes it has passed.

The lecturer begins by pointing out that this indirect use of light already forms an extensive subject; and he then specially selects for discussion half-a-dozen important branches of it. Many readers will, we fear, be disappointed when they find that *Dispersion* (whether ordinary or anomalous) is not included in this list. It is tantalising to feel that we are not (for the present at least) to have the opinion of the author on the classical researches of Cauchy, or on the more recent speculations of Sellmeier, Helmholtz, and W. Thomson. It would, however, be unjustifiable to construe this omission into an indirect assertion that we do not yet know for certain *what* Dispersion tells us:—though the parts of his wide subject which Prof. Stokes has selected for discussion are, each and all, such as give indications of a definitely interpretable character.

The first of these is Absorption. Here we have the explanation of the colours of bodies; the testing ray having gone in, and come out "shorn." This leads to the application of the prism in the immediate discrimination of various solutions which, to the unaided eye, appear to have the same colour. It is shown how, by a mere glance, the chemist may often be saved from fruitless toil, occasionally from grave error.

From the study of what rays are absorbed, the transition is an easy and natural one to the study of *what becomes of them* when they are absorbed. Here we have heating, chemical changes, phosphorescence, &c. The remainder of the lecture is devoted to an exceedingly interesting treatment of the beautiful subject of fluorescence.

The second lecture begins with Rotation of the Plane of Polarisation of light by various liquids, with its important application to saccharimetry. Then we have Faraday's discovery of the corresponding phenomenon produced in the magnetic field, with its application in the discrimination of various classes of isomeric compounds. But the author, true to his system of mentioning practical applications only, omits all reference to quartz under the first of these heads and to gases under the second. And he does not even allude to the interesting questions recently raised as to the form of the general wave-surface in these curious circumstances.

Then comes the "still vexed" question of the history of Spectrum Analysis. The present view of it must, of course, be carefully read:—it is much too long to be here extracted in full, and to condense would be to mutilate it. Of course the claims of the author himself are the only ones to which scant justice is done. But the President of the *British Association* of 1871 fortunately gave, in his opening address, the means of filling this *lacuna*. Just as the Gravitation-theory of an early Lucasian Professor was publicly taught in Edinburgh University before it became familiar among scientific men, so the present Lucasian Professor's suggestions for the analysis of the solar atmosphere, by means of the dark lines in the spectrum, were publicly explained in the University of Glasgow for *eight successive years* before the subject became generally known through the prompt and wide-spread publicity given to the papers of Bunsen and Kirchhoff! The following are Sir William Thomson's words of 1871:—"It is much to be regretted that this great generalisation was not published to the world twenty years ago . . . because we might now be [*sic*] in possession of the inconceivable riches of astronomical results which we expect from the next ten years' investigation by spectrum analysis, had Stokes given his theory to the world when it first occurred to him."

The third lecture is devoted to the information which spectrum analysis affords as to the chemical composition of the sun's atmosphere, and its physical condition; the classification of stars, the constitution of nebulæ, and the nature of comets. Those who still maintain that the temperature of the sun's body is comparatively moderate are very summarily dealt with. Then follows a passage describing, in homely language fitted to be understanded of all, the state of the sun's atmosphere. This is specially noteworthy, as showing how efficiently a Master can impress on his readers the most vivid ideas without requiring to use any but the simplest of language.

The remarks on the nebulæ and on comets will be read with great avidity; and, by the majority of readers, with some surprise. For it is stated that the planetary nebulæ, "making abstraction of the stellar points, consist of glowing gas." And of comets we find:—"There can no longer be any doubt that the nucleus consists, in its inner portions at least, of vapour of some kind, and we must add incandescent vapour . . ." An ingenious suggestion as to the source of this incandescence is introduced as the "green-house theory." The nucleus is supposed to be surrounded by an envelope of some kind, transparent to the higher but opaque to the lower forms of radiation. Thus solar heat can get freely at the nucleus, but cannot escape until it has raised the nucleus (in part at least) to incandescence. The coma and tail are formed by the condensation of small quantities of this vapour, so that they are mere mists of excessive tenuity. Herschel's suggestion, that the development of the tail is due to electric repulsion exerted by a charge on the sun, is spoken of with approval; and the production of the requisite charge of the mist-particles is regarded as a concomitant of condensation. Nothing, however, is said as to the opposite charge which the comet itself must receive, nor of the peculiar effects which would arise from this cause:—whether in the form of a modification of the shape of the comet's head, or of a modification of its orbit and period

made to put a value upon these increased quantities. In valuing wheat at 5*s*. per bushel and straw at 2*l*. per ton the compilers of the report made a great mistake, of which their critic has not been slow to avail himself. Here he "shells" them unmercifully and effectually, especially as the straw at 2*l*. per ton turns out to be the chief item for turning loss into profit.

This is, however, entirely an artificial value, the result of restricted supply, and Sir Thomas is perfectly justified in dismissing the item entirely by compounding it with the cost of the farmyard manure, letting straw and manure mutually discharge each other's claims.

Another point successfully urged is the smallness of the plots. What possible reliance can be placed upon plots 112th of an acre in which pounds per plot are at once alleged to represent hundredweights per acre. The multiplication of unavoidable errors, and the exaggerations of extremely local differences in the soil itself, are simply fearful to think of. The larger the area the better. If acre-plots could be used so much the better, and 10-acre plots would be better still—the only limit in size being, to our mind, convenience. But 112th parts of acres must induce a feeling of distrust in the breasts of those who are practically acquainted with land. The sources of error may be enumerated as follows:—imperfect distribution, unavoidable waste in distribution, minute differences in the soil, irregular germination of the seed, partial insect attacks, direct accidental injuries or the reverse (as, for example, an animal trespassing upon a plot, or a horse dropping his dung upon it), errors in weighing, errors in severance from the ground, and other unavoidable difficulties which belong to the carrying out of field experiments,—all of these errors are magnified in the case of small plots, and minimised by the use of large ones. In these directions the criticisms made by Sir Thomas Acland are valuable: but we should like to have seen a greater sympathy with an honest effort, and less anxiety to hold up any results of value as stale, antiquated, and unnecessary.

Any one who has lived as long as Sir Thomas Dyke Acland must know that the proclamation of things old as things new is not confined to agricultural chemists, and he should be more ready to accept as inevitable the *dictum* of the wise man, that "the thing that hath been, it is that which shall be; and that which is done is that which shall be done."

## *THE NEW EDITION OF "YARRELL'S BRITISH BIRDS"*

*A History of British Birds.* By the late William Yarrell, V.P.L.S., F.Z.S. Fourth Edition, Revised to the End of the Second Volume by Alfred Newton, M.A., F.R.S., continued by Howard Saunders, F.L.S., F.Z.S. Parts xx.–xxx. (London: Van Voorst.)

THE students of British birds have at last received the two final numbers of the new edition of Yarrell's celebrated work on their favourite subject, which was commenced as long ago as 1871. Fourteen years, it must be acknowledged, is a long time to wait, but on the other hand the subscribers to the new "Yarrell" have in compensation of the delay not what would be called in ordinary parlance a new edition, but what is, in fact, a complete and exhaustive summary of the present state of our knowledge of this subject, prepared by two of the greatest living authorities on British ornithology.

The two first volumes of the fourth edition of "Yarrell's British Birds," which were brought to a conclusion by Prof. Newton in 1882, were devoted to the birds of prey, the passerine birds, and the picarians. In June of that year Mr. Saunders undertook to finish the work, "not willingly nor with a light heart," but, as he tells us, "after considerable pressure and at much personal sacrifice." Forewarned by what had previously occurred, Mr. Van Voorst insisted that time must be part of the "essence of the contract," and stipulated with the new editor for the completion of the third and fourth volumes by June 1885, which, after allowing for six months' leave of absence, gave Mr. Saunders only two years and a half to prepare his account of nearly two hundred species. It cannot be denied that this was somewhat severe upon the new editor, and that, considering the pressure brought to bear upon him, the mode in which he has completed his task within the time assigned to him, deserves our highest compliments.

As has been already pointed out the so-called new "Yarrell" is, in fact, a new work. The vast amount of knowledge of British birds and their distribution acquired during the forty-two years which have elapsed since Yarrell's original work first appeared, rendered it absolutely necessary that such should be the case. It would have been much better, in our opinion, to have discarded the name of Yarrell altogether, and to have employed the leading ornithologist of the period to write a new work on British birds. But as Mr. Van Voorst, doubtless for sufficient reasons, preferred to retain the time-honoured name of Yarrell on the title-page, the new "editors" as they call themselves have, we think, surmounted the difficulties of their position with singular success. Where practicable, we are told, the original phraseology has been followed with due modifications, the opening words of the sentences have been preserved, and extracts from the authors and correspondents quoted by Yarrell have been retained. "This work of selection and adaptation has," we can well believe, "entailed severe labour." It is obvious, in fact, that it would have been a much simpler task to write most of the articles new from the beginning than to adapt those prepared by the original author fifty years ago to present use. The former plan would also, we think, have been more satisfactory to the reader, who between the "author" and the two "editors" and the friends and correspondents of each of them, is in many cases likely to be misled as to the real authority quoted for a particular statement.

While, as we have already said, the general execution of the "new Yarrell" merits our entire commendation, the systematic arrangement—an unsuccessful effort at a compromise between the old fashion and the new—does not seem to deserve equal praise. No doubt the order adopted by first editor for the three groups treated of in the first two volumes placed the second editor in a difficulty. But we cannot think that Mr. Saunders was thereby justified in relegating the Steganopodes, Herodiones and Anseres to the end of the series. With these groups he should have begun the second volume, not finished the third. At the same time it must be borne in mind that the primary object was not a strictly orthodox classification, but a good and readable "History of British Birds," and this object has, we think, been attained.

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## *OUR BOOK SHELF*

*Melting and Boiling-Point Data.* By T. Carnelley, D.Sc., F.C.S. Vol. I. (London: Harrison and Sons, 1885.)

THIS is a very large and important work, and one which cannot fail to be useful to the scientific chemist. It is divided into several parts, and contains, or rather consists of, tables of the elements, inorganic and organic compounds, their constitutional and empiric formulæ, melting- and boiling-points, and the authority and references to the journals, &c., in which the data are given.

The compilation of a work of this nature necessitates an enormous amount of labour and care, which in this case seems to have been expended, for misprints or misquotations appear to be absent.

It is the only one of the kind in English, although there are several German works of the same class, notably one by Richter, but of carbon compounds only. The only fault possible to find with a book like this, designed for use in the laboratory more than anywhere else, is its large size.

The present volume, the author tells us, contains 19,000 data, melting- and boiling-points, and with the second volume there is to be a total of about 50,000 data of this kind.

*American Journal of Mathematics, Pure and Applied.* Published under the auspices of the Johns Hopkins University. Vol. vii. Parts 2, 3, 4. (Baltimore: Isaac Friedenwald, January to July, 1885.)

THE first sixty-seven pages of Part 2 carry on Prof. Cayley's lectures on the abelian and theta functions, before the Johns Hopkins University (see NATURE, vol. xxxi. p. 189) to "the end of Chapter VII." Other papers in this part are "Solution of Solvable Irreducible Quintic Equations, without the Aid of a Resolvent Sextic," by G. P. Young (the same writer furnishes to Part III. "Solvable Irreducible Equations of Prime Degrees"), and "Notes on the Quintic," by J. C. Glashan. Mr. C. S. Peirce commences an article "On the Algebra of Logic," which runs into Part III.; it is in part concerned with a discussion of De Morgan's logic of relatives. M. Poincaré contributes a paper of fifty-six pages, "Sur les Équations linéaires aux Différentielles Ordinaires et aux Différences Finies." Capt Macmahon adds a short "Second Paper on Perpetuants." The Associate-editor, Dr. Craig, likewise briefly writes "On a Certain Class of Linear Differential Equations." Other short items in this part are: "Prufung grosserer Zahlen auf ihre Eigenschaft als Primzahlen," by P. Seelhoff; and "Sur les Nombres de Bernoulli" (following up a paper entitled "Some Notes on the Numbers of Bernoulli and Euler," by G. S. Ely, in vol. v.), by Prof. Teixeira, of Coimbra.

The first thirty-four pages of Part IV. are taken up with a paper by Mr. A. Buchheim entitled "A Memoir on Biquaternions," in which the author carries on his investigations in a field first opened up by Clifford. In it he aims at giving "a tolerably complete development of Clifford's calculus." Mr. J. Hammond carries on his labours on the lines of some recent papers by Cayley and Sylvester, by contributing a memoir "On the Syzygies of the Binary Sextic and their Relations." Prof. W. Woolsey Johnson writes "On a Formula of Reduction for Alternants of the Third Order," and "On the Calculation of the Operators of Alternants of the Fourth Order." Short notes are communicated by F. Franklin "On the Theore[illegible] $= \cos x + i \sin x$," and a "Proof of a Theorem of Tchebycheff's on Definite Integrals;" and W. E. Story supplies a paper on "The Addition Theorem for Elliptic Functions." The remaining article is an additional Bibliography of the kind of which the *Journal* has now published some three or four most useful specimens. On this occasion Messrs. Nixon and Fields have compiled eleven pages of "Bibliography of Linear Differential Equations." All such lists, if fairly complete, are bound to be most useful. The authors solicit corrections of and addenda to the list for future publication.

*A Guide to the Universal Gallery of the British Museum (Natural History).* By L. Fletcher. (Printed by order of the Trustees.)

THIS excellent little guidebook is worthy of the highest praise. It is a good deal more than a book which tells you the primary facts respecting the objects in the cases, inasmuch as it contains a simple and elementary introduction to the study of minerals. For such a purpose the principal crystallographic, physical, and chemical characters should be explained, and the way in which these characters serve as a means of classification should be shown. Mr. Fletcher has done this excellently. He shows how the science of crystallography grew by the discoveries of Steno, Romé de l'Isle, Haüy, and others to its present state, in which it serves as a most, if not the most, important element in the discrimination of minerals. The way in which Brewster's discoveries in crystal-optics confirmed the results of crystallographic investigation is pointed out; and a brief sketch of the progress of chemistry from the days of alchemy is also given.

This all leads up naturally to the ultimate purpose—that of classification, which is so essential in the proper display of a mineral collection. Finally, in the detailed account of the minerals in the Museum attention is specially directed to the more unique specimens.

*Die Spaltpilze.* Von Dr. W. Zopf. 3rd Edition. (Breslau, 1885.)

THIS, the third edition, differs in no essential respect from its predecessors. Zopf still adheres to the original proposition of Von Nägeli, that the various forms of schyzomycetes are not permanent species (Cohn), but various stages in the development of the same organism. This proposition is derived from observations of the morphological characters only, and is not based on sufficiently exact methods of *pure cultivation*.

The sections treating of the physiology and chemistry of the bacteria will be found very valuable. A complete and alphabetically-arranged bibliography at the end of the work is the best as yet published. E. KLEIN

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## *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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### The Evolution of Phanerogams

MUCH as I dislike controversy occasions arise when it must be faced; and Mr. Starkie Gardner's notice of the two new volumes by MM. Marion and Saporta (p. 289) calls for a reply. Personally I am obliged by Mr. Gardner's obvious desire to do justice to my views; but he must excuse me if I say that some of the "main facts" on which he relies are, like similar ones employed by the two French writers, charmingly independent of anything that I can find existing in nature.

Through the kindness of my accomplished friend, the Marquis of Saporta, I received copies of his two volumes as soon as they were published. [On perusing his descriptions of the carboniferous plants I found numerous statements with which I could not agree. Some of these statements refer to questions of facts; others to inferences drawn from real or imaginary facts. Having long enjoyed the valued privilege of a correspondence with my distinguished friend I sent to him a lengthy criticism of parts of his new volume which I thought to be seriously misleading; either because matters of fact were so exhibited as to convey erroneous impressions, and hence, practically, to become not facts—or because they were made to justify conclusions which the facts themselves, rightly stated, would not do. At the same time I gave my correspondent warning that I might have to correct what I regarded as his erroneous or misleading statements.

Mr. Gardner's article leads me to fulfil this announcement sooner than I intended, since he, in turn, has so far countenanced some of what I regard as the errors of the two French palæontologists as to make them his own. Like Mr. Gardner, M. Saporta had previously pointed out to me that the aim and object of his volumes did not necessarily involve interference with matters that have so long been in dispute between M. Rénault, M. Grand'-Eury, and myself. To this I could only reply that in his new work he had repeatedly shown his acceptance of views of these two palæontologists involving both facts and inferences, which I believe to be seriously erroneous. The space which NATURE can afford me will not suffice fully to review all of what I regard as the objectionable parts of the two volumes under consideration, but I may be allowed to make some comments, including some extracts from my letter to M. Saporta, indicating the nature of my objections both to his conclusions and to the comments made upon them by Mr. Gardner.

The latter gentleman makes one statement which I cannot endorse. Because MM. Rénault, Grand'-Eury, and Saporta all adopt the views of M Brongniart he thinks it hardly possible that they can all be mistaken. This argument cuts both ways—Mr. Gardner applies it to the subject of Calamites *versus* Calamadendron. On this subject I may retort that when such men as Schimper, Weiss, Stur, and perhaps my prolonged investigation of the subject justifies my adding myself, take an opposite view of the matter in debate, it may possibly be equally impossible that we, with our vast array of specimens in our cabinets, should all be mistaken! This *argumentum ad hominem* therefore falls to the ground. I may be allowed to wonder that it should ever have been advanced.

The first point to which I would call attention shows that such men as those quoted may blunder and have blundered. I now refer to the subject of the relations of Lepidodendron and Sigillaria to each other and to the rest of the plant world. That I have for many years insisted upon the cryptogamic character of, and the close affinity existing between, both these genera is well known; and equally so, that many of the French palæontologists have followed M. A. Brongniart in regarding the Lepidodendra as Lycopodiaceous plants whose stems contain no exogenous vascular cylinder, whilst all those plants that possessed such a cylinder (a product of a Cambium layer) which they believed to be the case with Sigillariæ must, *de facto*, be Gymnosperms. That this dispute has now been settled in my favour by an important recent discovery does not seem to be known to Mr. Gardner. M. Zeiller has obtained strobili of Sigillaria which have settled the matter even in the opinion of most of the Parisian botanists. Those strobili contain spores, not seeds. This discovery demonstrates the cryptogamic character of Sigillaria, and deals a final blow at the Gymnospermous hypothesis held by the four observers in whose combined infallibility Mr. Gardner expresses such confidence.

My first friendly complaint against the authors of the "Evolution of the Phanerogams" is that they disregard proven facts when such facts inconveniently oppose their theories. *Imprimis*, they became aware of M. Zeiller's important discovery whilst their volumes were passing through the Press. Though this is a sufficient reason for only noticing it in a footnote, it does not justify their very slight recognition of its bearing upon so many pages of their arguments, of which it effectually disposes. It absolutely establishes the fact that *some* Sigillariæ, at least, are *not* Gymnosperms but Cryptogams; which fact, superadded to the many identities of structure in Sigillaria and Lepidodendron, which I have repeatedly shown to exist, renders it increasingly probable that the above statement is applicable to *all* Sigillariæ. At least, it now throws upon the opponents of that statement the onus of proving the contrary to be true, which they have not done.

Several years ago the late Mr. Binney described what he believed to be two plants—the *Lepidodendron vasculare* and the *Sigillaria vascularis*. That the only difference between these two was the possession, by the latter, of an exogenous zone, not seen in the former, was recognised by Mr. Binney. I have shown in a way, which I claim to be unanswerable, that these are one and the same plant which the external and internal characteristics alike demonstrate to be a Lepidodendron. Hence I complain to M. Saporta, "You continue to speak of *Sigillaria* vascularis. I reply that there is no such plant; and to speak of the *Lepidodendron* under that name, after all that I have done in illustration of its organisation, is unfair to me, besides seeming to support M. Rénault's absurd conclusion that an exogenous or centrifugal zone is incompatible with the possibility of a plant possessing such a zone being a Lepidodendron." I then state "further, after enumerating M. Rénault's three supposed types of Lepidodendron, from which he excludes all possibility of the existence of an exogenous zone, you say, 'ce sont les traits *essentiels* des types caulinaires Lepidodendroides.'

"I reply in language as strong as I can possibly use that this is not true. The development of an exogenous zone in the more advanced stages of a Lepidodendron's life is the rule rather than the exception."

After citing numerous proofs of this statement I say in reference to Sigillaria: "It is further a mistake to say that 'ces tiges nous sont principalement connues par les Sigillaria elegans et spinulosa.' We possess the vascular axis of the Sigillaria figured in my Memoir II., Fig. 39. This axis is identical in the minutest details of its organisation with those of the Diploxyloid Lepidodendra, and I have sections of Sigillaria reniformis which are, in structure, equally Lepidodendroid. I ask, therefore, what are the 'diversités appréciables' to what you refer on p. 23, and what ground have you for saying that this double fibro-ligneous region is 'sans analogie avec ce qui existe dans les tiges connues des Lepidodendrées'?"

On this part of the disputed questions I must object to a statement made by Mr. Gardner, in which he says that the structure of Lepidodendron "presents nothing unusual to Cryptogams." Surely a thick *exogenously developed* cylinder of scalariform vessels, arranged in radiating laminæ, separated by true medullary rays, the entire structure being produced by a Cambium zone, is very unusual in Cryptogams. Mr. Gardner then proceeds, as M. Saporta would do, to describe a contrast which has no real existence. "But in Sigillaria, a plant strongly resembling it in nearly every other respect, we find a radiating vascular or woody zone in the cellular stem with unmistakable exogenous growth. It is richly supplied with medullary rays, and, Prof. Williamson allows, presents clear evidence of interruptions to growth succeeded by periods of renewed vital activity." I allow, and never have allowed anything of the kind,[1] if this means my admission that something exists in Sigillaria that does not exist in most Lepidodendra. Mr. Gardner further represents me as believing that "the typical Lepidodendron never produced a ligneous zone." I believe the reverse of this; viz. that a development of such a zone sooner or later was characteristic of most Lepidodendra. True there are some Lepidodendra in which I have not yet discovered such a zone; but I am far from supposing that even in them such a zone will not ultimately be discovered. Anyhow the *typical* Lepidodendron can no longer be regarded as one from which this zone is absent. Mr. Gardner, after the passages quoted above, says: "In Diploxylon there is a further development, the woody zone being made up of an inner or medullary vascular cylinder either interrupted or continuous, composed of large scalariform vessels without definite order, and an outer cylinder of scalariform vessels of smaller size arranged in radiating fasciculi." What does this "further development" mean? This description is simply that of *every* exogenous Lycopodiaceous axis found in the coal measures, whether of Lepidodendron or of Sigillaria. Diploxylon, *as a genus*, has no longer any existence. The term is now useful only as an adjective descriptive of a condition of growth common alike to Lepidodendron and to Sigillaria, as well as to several other genera of Carboniferous plants. Unless I misunderstand Mr.

[1] I may here observe that conspicuous or even visible interruptions to growth are very rare amongst these coal plants. They are only very *conspicuous* in my genus Amyelon; but we also find traces of them in Stigmarian roots and in Lygenodendron. Generally these Carboniferous stems suggest the reverse of changing seasons or periodic interruptions of growth.

### Preventing Collisions with Icebergs

ALTHOUGH it is, I believe, ascertained that fogs are often highly athermanous, I would, at the same time, like to ask whether a thermal radiation method might not serve to show the presence of a large mass of ice in the neighbourhood of a ship. I venture to make the suggestion, as I know of no experiments on the degree of athermancy possessed by fogs, as tested by such an instrument as the bolometer of Prof. Langley. The use of this instrument, or even of the thermopile, in conjunction with a large reflector and an alarm circuit closed by galvanometer deflection, might be worth trial by any one possessing the opportunity.

J. JOLY

Engineering School, Trinity College, Dublin, August

### Monkeys and Water

Is it a usual thing for monkeys, either in captivity or in their native condition, to take freely to the water? Some relations of mine have a small monkey that was brought to them from Java, and which is a great pet. One day it was thought that he should be bathed, and he was put on the edge of the bath. In a little while he hung down from the edge by a foot and hand, and drank the water, and then, plunging in, he swam backwards and forwards under the water, with his eyes open, with great enjoyment.

After the first time he was frequently bathed, and a day or two ago I saw him go through the performance. It was very pretty to see how he enjoyed it, swimming under the water and diving away from a hand put down to take him; then going head over heels at the bottom and lying on his back to bite playfully at a finger; then he would run about on all-fours with his head held out of the water, and then go under again: and after it all, when he was taken out and dried with a towel, he lay wrapped up in a shawl, sleeping comfortable and happy. I should like to know whether he is an exception to the rule in his love of the water.

JERRY BARRETT

15, Avenue Road, Regent's Park, August 6

### A Correction

I HAVE very stupidly made it appear in my note on pitcher plants, printed in last week's NATURE (p. 341), that Dr. McBride was President of the Linnean Society in 1815. I ought to have written, "In 1815 the then President of the Linnean Society read a communication from Dr. James McBride," &c. I suppose Sir James Edward Smith was at that time President of the Linnean Society, and that Dr. McBride never was.

W. WATSON

August 15

## *A MODEL UNIVERSITY*

THE following information for applicants for admission to the Johns Hopkins University, printed in the University Circulars in response to letters, we are sure will be read with interest and profit:—

*How was the University Founded?*—The Johns Hopkins University was instituted by the munificence of a citizen of Baltimore, Johns Hopkins, who bequeathed the most of his large estate for the establishment of a University and a Hospital. The foundation of the University is a capital, in land and stocks, estimated in value at more than 3,000,000 dollars; the capital of the Hospital is not less in amount. The University was incorporated under the laws of the State of Maryland, August 24, 1867, and it was opened for instruction in September, 1876. The Philosophical Faculty (of Letters and Science) is now organised. A medical department will soon be instituted.

*In what is Instruction Given?*—Systematic instruction is offered in English, Anglo-Saxon, German, French, Italian, Spanish, Latin, Greek, Sanskrit, Hebrew, Arabic, and in other languages and literatures; in pure and applied mathematics; in chemistry (inorganic and organic) with laboratory work; in physics (including mechanics, light, heat, sound, electricity, magnetism, &c.), with laboratory work; in biology (including physiology and morphology) with laboratory work; in mineralogy and geology; in ancient and modern history; in physical geography; in political economy and in the elements of international law; in logic, ethics, psychology, pedagogics, &c. Occasional courses of lectures are also given upon special themes in literature, science, history, archæology, art, &c.

*To whom is this Instruction offered?*—To all young men who are prepared to profit by it and who will conform to the simple regulations which are established by the authorities. Graduate, Undergraduate, and Special Students are received.

Those who have not already received an academic degree, should aim to secure one by pursuing a liberal and prolonged course of study, at the close of which the degree of Bachelor of Arts will be conferred. Those who may be prevented from seeking this degree will nevertheless be welcomed to the University, provided that they are in earnest and are mature enough in years, attainments, and character to profit by the advantages which are here afforded. Others who have already taken their first degree are encouraged to go forward in advanced lines of work, and for them unusual facilities are provided. Young men who are to pursue the study of law, medicine, or theology, or who have entered upon professional lives, and others who expect to become teachers, if they desire to become proficient in literature and science, have easy access to the class-rooms and laboratories. The degree of Doctor of Philosophy may be obtained, after three years of advanced study, by those who have met the required conditions.

*How is this Instruction given?*—By all the methods which experience has shown to be useful—varying according to the preferences of the teachers, the subjects taught, and the number of scholars. There are recitations, lectures, conferences, prolonged courses in laboratories, exercises in special libraries, personal counsel, study of nature out of doors. The usual four-year classes are not maintained, but in all the principal subjects taught there are beginners, intermediate students, and advanced workers; so that every scholar is assigned to that position in each section of the University which will yield him the greatest advantages. He may be far advanced in one subject and only a beginner in another. This result is only secured by the engagement of a large staff of teachers.

*What are the Laboratory and Library Facilities?*—The scientific laboratories are three in number. They are open throughout the day and are fully equipped. For chemistry there is a special building arranged for about ninety workers, and well adapted to all kinds of chemical and mineralogical work. A large building has been recently constructed for a biological laboratory, with complete arrangements for physiological and morphological work. The physical department is furnished with apparatus selected both for demonstration and investigation, and especially valuable for researches in electricity, magnetism, light, and heat. The construction of a new building for a physical laboratory is now under way.

The library includes over 26,000 bound volumes, and 650 serials are regularly received. It is open thirteen hours daily. The library of the Peabody Institute, with 80,000 volumes, and the other Baltimore libraries, are of easy access. Washington is so near that the Library of Congress, the National Museum, and the other libraries and museums of the capital may be readily visited.

*What are the Necessary Expenses of a Student?*—The charge for tuition in all departments (including the use of the library, and without any extra charges except for materials consumed in the laboratories), is 100 dollars per annum, payable one-half October 1, and the other half February 1.

Young men living in any part of Baltimore, or in the immediate vicinity, can lodge at home, as the first lessons

corresponding advances in connection with the spectroscope and sidereal photography. The three combined constitute a distinct feature in the more modern methods, by which we are gradually becoming better acquainted with the infinite remote. So soon as molecular physics shall have made, as is promised, a like advance, then the infinite minute also will be brought more distinctly within the human ken.

With regard to the Harvard volume on Sidereal Photometry, without unreservedly conceding to it all the accuracy to which it lays claim, it must be gratefully acknowledged that it provides astronomers with a consistent and valuable catalogue of stellar lustre which, in a complete form, had not hitherto existed. It dispenses with the too often unreliable and discordant estimates of the past, and replaces them by scientific measures possessing, to say the least, considerable precision.

The two parts of the volume contain together no less than 512 closely-printed pages, many of them abounding with models of condensation, and constituting in themselves a remarkable instance of sustained and successful scientific labour. They embrace not only the general history of the subject to which the volume refers, but they at the same time combine elaborate criticism and valuable comparisons of the results of preceding labourers in the same field.

In the first part there is given a description of the meridian photometer, with which the measures of comparative lustre of the stars are obtained. In it are most ingeniously combined the more valuable and least dangerous devices which are found in the instruments devised by Sir John Herschel, Steinheil, and Zöllner. Taken as a whole, the instrument may be properly regarded not only as ingenious but as original. Roughly speaking, it consists of two contiguous telescopes placed horizontally nearly in the meridian, each of the object-glasses being armed with a reflecting prism, so that the light from Polaris and any other star may be brought into the same field of view, after having passed through a double-image prism. The images are then viewed through a Nicol prism, and, by means well known to physicists, the light of the one star is reduced by a measurable amount until it is adjudged to be equal to that of the other star.

We trust we may be pardoned if we suggest that this construction of the instrument may possibly be too complicated to admit of that amount of precision in the measures which could be desired, and which might be obtained by simpler means. In fact, it appears from the volume itself, that at the commencement of operations, it was necessary to abandon the results of several months' work with it; and although an improvement in the use of it was subsequently adopted, we think there still remain traces of the possibly inherent difficulty of precise adjustment. The rapidity also with which the equalisation of brightness of each star with that of Polaris is made, seems hardly consistent with the requisite precision. It is to be inferred from the volume itself that as many as forty-eight final determinations, each consisting of four equalisations of the light of a star with that of Polaris, are frequently completed within the hour, in addition to the consumption of time required for finding and identifying the successive stars and adjusting them in the field of view. But, we cannot doubt, this point has been well considered by the Harvard astronomers themselves.

In the determination of the magnitude of a star, it is the usual practice to rest content, generally, with the mean of three determinations. Each determination is made on a different night, and consists of the mean of four equalisations of the lustre of the particular star compared with that of Polaris in the field of the photometer. We venture to think that the general limitation to three only is too restricted for the purposes of accuracy. The reason for this opinion is derived from the fact that on examining the numerous cases in which as many as fifteen determinations of magnitude are made on as many nights, it is very frequently, and in fact generally, possible to find three consecutive determinations which would of themselves, in the mean, lead to a magnitude widely different from that ultimately assigned. Yet these three consecutive sets furnish no circumstance of inter-discordance among themselves which could lead to suspicion, and which might, consistently with the usual practice, have finally settled the magnitude of the star in question. We regard this not as hypercriticism, but as being the only sufficient means at hand for the examination of accuracy furnished by the volume itself.

Independently of the several catalogues containing the results of three years' unremitting labour and persevering skill, the volume abounds with the intercomparison and reduction to one scale of the work achieved in a similar direction by many preceding astronomers. The result is that astronomers who are desirous of information on the subject of stellar brightness, will probably not be disappointed if they turn to the pages of the Harvard Photometry. Combined with a memoir by Prof. Pritchard, contained in vol. xlvii. of the *Memoirs* of the Royal Astronomical Society, it is perhaps not too much to say that all that is known upon the subject up to the present date will be found easily accessible to the student.

Towards the conclusion of the volume Prof. Pickering has drawn up a very important table, which, though short, must have given him very considerable labour to compute. It contains in one summary a critical comparison of the average results of all the principal catalogues of stellar magnitude hitherto published. The Harvard Photometry is taken as the basis of the comparison, and the difference between the mean or total results of each catalogue and that of the Harvard volume is given. From the inspection of Table lxxxiii. it appears that, taken as a whole, the Harvard measures indicate in the mean a brightness of the stars compared greater than that indicated by the estimates in the *Durchmusterung* of ·14 mag., brighter than the mean of the Uranometria Nova of Argelander by ·10 mag.; of Heis by ·12 mag.; and of Houzeau by ·11 mag. These differences, it will be observed, are all in one direction, and might appear to indicate that there is a generic difference between estimates of star magnitude by the unaided eye, and measures carefully made with a photometer such as is the meridian photometer at Harvard College, because all the estimates are apparently fainter than the measures. But this can scarcely be the true explanation, since the photometric measures also of Seidel, Zöllner, and Peirce indicate, like the eye estimates, a brightness less than that of the American determinations. Moreover, the photometric measures made by Prof. Pritchard at Oxford agree in the mean of the whole, very closely with the eye estimates in the *Durchmusterung* and the other catalogues. But, whatever the significance of this fact may be, it cannot be doubted that the Harvard volume will ever remain a most valuable addition to our knowledge in an important branch of astronomical science.

## *U.S. INDUSTRIAL STATISTICS*[1]

TO all who study anxiously social science, this is a very promising publication; its indirect testimony to the advantages of Republican institutions will be weightier to any reflective man than the eloquent tirades that are so usually bestowed upon them. It defines its object to be the stimulation and assistance of the wage-worker in his endeavour to reach a higher position. Its information respecting working men is all taken from their own contributions, a dozen pages of small print being filled with verbatim quotations from the replies of workpeople in every trade in the State, who give such

[1] "Sixth Annual Report of the Bureau of Statistics of Labour [and] Industries of New Jersey," 1883." Trenton: New Jersey, 1883.

varied accounts of themselves that the independence of the testimony cannot be doubted. That its work is popular is indicated by the wish expressed by one of them that "there should be a National Bureau." Factory legislation is printed in it (even 1884 legislation, although the printer's date is 1883!); the factory inspector has become a popular institution, and much testimony is borne to the smaller hardship of factory laws uniformly than loosely enforced. The more educated and more prosperous workmen are, the more ambitious and aspiring they become, and we seem on the eve of their blending with their masters when complaints are made, as here, that many of their fellow-workmen are satisfied with *only* 66 shillings a week wages; and a caution is held forth to such not to spend their money in foolishly aping the rich.

Yet, though the teacher here is no longer one of the fatherly governments of the old world using his paternal authority for the good of a rather refractory son, yet the teaching is most satisfactorily similar. Drunkenness could not be set forth as the prevailing cause of pauperism among the men or the evil of a lack of artistic taste among the masters in more vivid or unqualified terms than they are here. The sad combination of progress and poverty is bewailed, but we fear that co-operation urged here as its remedy too much overlooks the control of fashion and its effect upon supply and demand. A most practical power put in the hands of this Bureau is that of examining the accounts of co-operative companies. Any five members of a company may require such an examination.

The principal industries of New Jersey are taken, and, after full statistics of their amount, prosperity and prospects, with the wages earned by each class of workers, an interesting account is given, commencing with a short history of the methods, improvements, and general position of the trade in the United States and in other countries, and their experience compared. Any one casting about for an occupation in which he could take a satisfactory part would find in this "Book of Trades" much to supply the information first required, and much to encourage him. Among them we find a review of the silk trade, which, under the ægis of 60 per cent. duty, has made the wealthy city of Paterson; of glass-making, which at present does not extend much beyond window glass and bottles; of the cultivation of sorghum, still in its infancy in New Jersey; and of the pottery trade—after its account of which it performs the very useful function of a publication like this of appealing to such a trade to take the steps necessary for raising their standard of art. An appeal is made, not from a Government department, or from an interfering *clique* as South Kensington is occasionally regarded as being, but by the organ of his late fellow-workers, that the maker of one of those large fortunes so common in America will, for his country's glory and their help, found a technical school; while hands are led to feel that intellectual training and not mechanical energy alone is wanted. The idea is shown here also to be making its way that the school should be made the basis of technical as well as of mental training; that the dextrous use of the body should form part of the school, as well as of the playground, teaching. More than this, it is felt that they should not be two so distinct branches of education as in past days, and that the members and muscles of the body, as well as the brain, should receive elementary instruction at the school, and that the former should be placed more deliberately under the control of the latter. It is felt in America that

> "The cultured mind
> The skilful hand"

ought naturally to go together, and not that one should be th[illegible]mark of the absence of the other; that, therefo[illegible]c should not mean little more than a [illegible]echanician, able to understand, make or repair the giant body that is using its limbs to save his exertions, and therefore a man more on a level with other men whose time has been given to the cultivation of their minds only, and more justified in insisting upon their equality with the latter. It is urged in this Report that elementary technical knowledge valuable to all the New Jersey trades may be given in ordinary schools; that technical learning is popular, frequently most so to boys who are slow at books; and that successful manual occupation improves the morality of the worst of such boys.

A very favourable notice of the Reformatory school at Coldwater; a sad tale of jail arrangements, and of methods of keeping the poor, all lead to discussions of economical difficulties felt long ago in England, not by any means avoided in America, and showing how little forms of government can modify human nature. A more hopeful view of that is afforded by the account, illustrated with three engravings and three plans, of a working-man's Institute at Millville. At this one establishment, which seems to have cost little more than 4000*l*., are combined, besides large grounds used for field sports, bicycling, &c., a gymnasium and baths in charge of a barber in the basement, while on the ground floor are a conversation room hung round with maps and supplied with musical instruments on which performances are given, where also lectures are delivered, discussions held, and games of s[illegible] played. Side by side with it is a library and reading-room. Up stairs are four class-rooms and a large hall seating [illegible] persons, besides a gallery over the rear half of it. At the other end of it is a stage with two dressing-rooms and other necessary adjuncts. This room is used on Sundays as well as on weekdays by various societies—a choir class among others—and is a convenient source of revenue.

It is impossible to lay down our Report without fee[illegible], that if each department of its work is by itself of li[illegible] importance, it will doubtless be a useful agent in making every inhabitant of New Jersey and of the United States a more intelligent worker at his trade or surveyor of the economies around him.

## *PIERCING THE ISTHMUS OF PANAMA*[1]

THREE years ago the work of cutting through the Panama isthmus had barely commenced. Le equatorial forests on the neck of land, 73 kilometres long, which marked the axis of the future interoceanic canal, had hardly been laid bare. The traveller who followed the primitive road met here and there some groups of cabins, with roofs of branches on poles, marking the site of a sounding or the improvised dwellings of a portion of the operators. Culebra, Emperador, Corosita, and Gamboa, which are now full of activity, were then almost desert, and on the coast of Colon alone the excavator traced in the marshy plains of Gatun the great track. The contrast to-day is great: a long line of workshops covers the space between the Atlantic and the Pacific. Twenty thousand workmen toil on the Cordillera, making the deep cutting for the canal. Side by side with this army, another more powerful army—colossal machines, excavators, dredges, locomotives, waggons, all the materials for transport, thousands of pairs of wheels, hundreds of kilometres of rails, mountains of coal, and shiploads of dynamite. Among the twenty-five workshops of the peninsula the attention is chiefly attracted to two points; the great rocky cutting of Culebra, which is to penetrate to a depth of 120 metres into the Cordillera, and the dam of the Chagres at Gamboa. At Culebra the previsions of M. de Lesseps have been realised: the mountainous mass which the canal will traverse is, for the most part, composed of rocks which are not very hard; repeated soundings by means of diamond perforators have shown that down to a

[1] Abstract from *La Nature*.

considerable depth the rock takes the form of schists in horizontal strata. There is no doubt that it can be cut through with rapidity; it is a matter of perforation, either by mining and ordinary explosives, or by shafts with larger quantities of some explosive to displace great masses. Here 30,000 cubic metres of rock have been displaced by an explosion of dynamite; and unquestionably this colossal channel connecting two seas may be executed by simple methods and with economy.

At the end of the great cutting of Culebra, 6 kilometres from Emperador, is the great workshop for the dam across the Chagres. This gigantic basin, containing about 1,000,000,000 cubic metres of water, the surface of which is 60 metres above the water of the canal, has a bank, the content of which is 7,000,000 cubic metres. The volume of water kept in by this exceeds a hundredfold that of any reservoir in the world. By means of this work inundations in the river are prevented, currents impeding navigation and introducing rough water into the canal are avoided, and there is no fear of the accumulation of alluvion in the bed. By regulating the flow of the Chagres and of the neighbouring streams, the dam at Gamboa assures the regular service of the canal. The method of constructing this work of proportions without precedent in the annals of public works is a very simple one. From the great cutting at Culebra, near Gamboa, and the neighbouring cuttings, about 50,000,000 cubic metres of rock are removed, while only about 7,000,000 are required for the Chagres dam, and therefore the work is one of transport only—a colossal one, it is true. Even the site of the dam is formed naturally by the disposition of the bed of the torrent, which is contracted at this place between the hills of Obispo and Santa Cruz, which are distant about 150 metres from each other, and on which will rest the front wall of the great reservoir. Behind this first barrier will be thrown, as they are taken from the Cordillera, the 7,000,000 metres of rock, and the dam will be complete. The originality of the project is that, strictly speaking, there is no masonry at all in this enormous mass of rock of all sizes and shapes; the accumulation alone gives the mass firmness. The plan given here enables us to follow the sinuous course of the Chagres River. Like all torrents, and especially all torrents in equatorial regions, it is subject to considerable variations in its flow, and to enormous and violent floods. In winter its flow is 1600 cubic metres per second, while in spring it is barely 13 metres. Its tributaries, or *rios*, are of the same character—the rio Trinidad and the rio Gatuncillo have a flow in winter of 400 cubic metres. It would be impossible to divert these impetuous masses of water into the canal without producing currents and deposits and impeding the navigation. The overflow of exceptional floods will be conducted to the sea by secondary water courses. These latter, which vary in breadth from 8 to 12, and even to 40 metres near the Atlantic, are easily made by utilising the portions of the bed of the river situated on the same bank, and connecting them by appropriate trenches. The enormous reserve behind the dam will flow regularly in this new bed. Of course, the bed of the canal will be completely protected from these deviating waters, in the trenches by the slopes of the latter, and in the lower parts by banks which will soon be covered by a vigorous and indestructible tropical vegetation. With the construction of this reservoir, assured by the clearings from the cutting, and the water regulated and controlled by these courses, the work, like that of the cutting at Culebra, is only one of time. One objection which was raised when the public became acquainted with the almost incredible magnitude of the work, in which a reservoir becomes a great lake, was that this latter might itself be filled up with the alluvial deposits, which it was constructed to keep out of the canal. It is true that in its tropical floods the Chagres carries along a large quantity of alluvion; but this, which would be an insuperable obstacle in the canal, becomes a secondary consideration in the reservoir. It has been calculated by the chief engineer to the work that the Chagres can bring into the lake in *a thousand years* 30,000,000 cubic metres of alluvion, while the cubic content of the lake is 1,000,000,000 cubic metres.

Culebra and the dam at Gamboa have always been the two principal points, the main obstacles to the canal. But there are thirty-five other principal working stations, all connected with the railway between Colon and Panama. As the illustration shows, they are sufficiently near to each other to be considered uninterrupted. Fifty excavators and ten dredges work at the canal. Up to the twenty-fifth kilometre we meet with dredges, at first at Colon for the port, then at Gatun. As far as the Panama Plain there are more than sixty excavators. In the three workshops at Culebra are now installed the contractors who cut the canal from Amsterdam to the North Sea. At Corosal, at the sixtieth kilometre, the great port for access to the canal from the Pacific is to be placed, and there the great American dredges work in the swampy ground. It has been calculated that the work done up to the present is half that required to complete the undertaking, and that this new maritime route to the East will be opened in 1888.

The work stands at present in this position: it involves in all the movement of about 100,000,000 cubic metres of rocks of varying consistency. Of this, 70,000,000 are to be raised, according to the contracts, in successive instalments in 1885, 1886, and 1887. The remaining 30,000,000, which form the actual canal, will be raised at the expiration of this time either by the same contractors or by new ones. Knowing the amount already raised, the contract periods for raising a certain other quantity and the amount remaining to be done at the end of the present contracts, we can, by a sum in simple proportion, calculate when the whole should be completed. In 1888 it should be ready for traffic. This simple programme could only be applied to a work so colossal after a long and laborious period of minute study and preparation. The period of installation is always the most important in all these vast enterprises: the study and command of the appropriate material, the reception, testing, arrangement of the machines, the construction of the workshops, accommodation for the workmen, &c.; it is only when all these have been completed, when all have been made ready for work and tested, that the real work can commence, and that progress becomes sensible. This period of installation lasted, for example, in the case of the St. Gothard tunnel, for fifteen months; but the Panama canal calls for ten times more capital than the tunnel, it is executed in a country which has first to be cleared of a luxuriant tropical jungle, thousands of miles away from all industrial centres. The preparation for this gigantic work under these circumstances was a most important fraction of the work, and it is the opinion of competent men that what has actually been done during the installation period now brought to a close is equivalent to half of the work necessary to achieve the canal. In the case of the Suez Canal, 70,000,000 cubic metres had to be raised; of these, 50,000,000 were raised in two years after the apparatus had been put in working order. Seventy million cubic metres must be raised by the drags and excavators of the twenty-one principal contractors; 18,000,000 are to be raised by August 1 of the current year. These 21 contracts represent an outlay of about 240,000,000 francs, of which 65,000,000 have been tendered by French contractors; 55,000,000 by Americans; 20,000,000 by Italian, Swiss, Swedish, and natives, and 90,000,000 by an Anglo-Dutch Company. All nations are working therefore at the task. The French contractors are at work at the cutting at Emperador; the Anglo Dutch Company has to remove 13,000,000 cubic metres in the great cutting at Culebra. Practical" the whole isthmus is being attacked simultaneously. Fig. 4 represents the work at the station of Emperador. It is connected by rails, on which locomotives run with other stations, and with the Colon-Panama Railway. The material taken out is conveyed to the great dam, which is to keep in the water of the Chagres River. The cutting at Emperador is 200 metres wide in certain places. Next to the [illegible] the great station of Culebra. These [illegible] stations are represented in the accompanying sketches. While all this work [illegible] dredging and excavating, making cuttings and embankments is going on at the canal, the two ports of entry [illegible] the Atlantic and the Pacific are being constructed. [illegible] Colon, powerful dredging works are opened. A [illegible] protected on the western side by a mole, has been [illegible] on which a new town, Christopher Columbus, is growing. On it are placed the workshops, stores, railway [illegible] &c. All the constructions are connected with the [illegible]

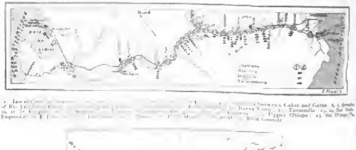

Fig. [illegible] Between Colon and Gatun [illegible] Tavernilla [illegible] Obispo [illegible] Bas Obispo [illegible]

way across the isthmus [illegible] drawing any amount of water [illegible] projecting into the sea, and completely [illegible] wind. On the Pacific coast, the [illegible] mouth of the Rio Grande presents [illegible] and six dredges are now at work, making [illegible] metres in width to the sea. A special [illegible] been created to deal with the vast material, [illegible] ment, and repair. The isthmus has been divided into [illegible] the [illegible] at Matachin, at the foot of the [illegible] and the cutting. Here all the material is [illegible] all the repairs executed, and all the machinery put in working order. The railway of the [illegible] facilitates greatly the movement of the machinery on which the regular working of the various sections depends. [illegible] each working station is in communication with the central one and with every other.

To sum up, more than two-thirds of the work of making the canal is now in execution, under formal engagements with contractors. The problem of the canal has been solved in principle. The period of installation or preparation has been succeeded by one of execution, based on a definitive programme, accepted by those who must carry it out, the Company itself maintaining an attitude of rigorous surveillance.

## NOTES

The fifty-eighth meeting of the German Association of Naturalists and Physicians will this year meet at Strasburg. [illegible] Thursday, September 17, and terminate on September 23.

[illegible]

Gaboon. *Megaloglossus woermanni*, as this new mammal is proposed to be called, is remarkable as belonging to the long-tongued division of the Pteropine Bats, which was not previously known to occur anywhere within the Æthiopian region. *Megaloglossus* is closely allied to *Macroglossus* and *Melonycteris*, and in some characters is intermediate between these two genera. In its dentition it also exactly resembles them.

We are informed by Dr. G. A. Guldberg, of the University of Christiania, that the fishery of rorquals or fin-whales (*Balænoptera*) [illegible] at Vadsö in East Finmarken, for commercial purposes, continues to be turned to good account for scientific investigation. This year Dr. R. Collett, the well-known Norwegian zoologist, is visiting the place, and has already made many interesting observations upon the structure and habits of Rudolphi's whale (*Balænoptera borealis*), which has been captured in considerable number during the latter part of July, although the great blue whale [illegible] generally so numerous [illegible] upon the coast. This is attributed to the [illegible] of the [illegible] *inermis*, a small crustacean [illegible] Rudolphi's whale is called [illegible] by the Norwegians, as it appears on the coast [illegible] also a crustacean [illegible] the chief nourishment [illegible] It usually visits the coasts of Finmark [illegible] May and August, and has lately been [illegible] November 1883 [illegible] Dr. Guldberg gives its [illegible] sometimes attains 50 feet [illegible] the commoner species [illegible] resembles. Its colour is black [illegible] the latter species [illegible] with white, and [illegible] A new [illegible] have been lately put [illegible] wholesome, and to find [illegible] fish according to the [illegible] on fast days.

We [illegible] for the past year of Prof. [illegible] the Smithsonian Institution [illegible] the National Museum [illegible] A sketch of the work of the [illegible] Geological Survey [illegible] the Museum [illegible] partly upon the [illegible] Ethnological Bureau [illegible] miscellaneous explorations [illegible] explorations [illegible] publications [illegible] Prof. Asa Gray, part II. of [illegible] there are 8 genera [illegible] species [illegible] 237 genera and [illegible] nearly 500 pages [illegible] commenced in 1883 [illegible] the engravers [illegible] the extension of [illegible] of the United States [illegible] Montana, Idaho, Nevada, Texas, Utah, New Mexico, and Texas remain [illegible]

[illegible]

… the origin of which has hitherto been regarded [illegible] problematical, by this theory.

[illegible]

## GEOGRAPHICAL NOTES

[illegible]

[illegible]

still left him when awake quite conscious and able to understand, &c., using the remaining [illegible] and ear for social intercourse. Now when these were carefully closed he became unconsciously, as in sleep, [illegible] and he was aroused again, [illegible] the same hours.

Hence the higher structures of the brain [illegible] organ [illegible] the [illegible] of the mind, [illegible] dependent upon [illegible] range from the sense [illegible] the area.

[illegible]

But to return. In consequence of the obvious fact that we have two sense-organs, each more or less complete, some writers have imagined that we have two minds, and to the Rev [illegible], [illegible] of this Institution, is due the credit [illegible] circumstances which seem to favour that [illegible] I am ashamed to say has escaped [illegible] two souls.

Now the [illegible] upon which this notion rests, that the two halves of the brain might occasionally work independently of [illegible] at the same moment, was of two kinds. In the first place [illegible] we could do two different things [illegible] and in the second place evidence was produced of people [illegible] that they had two minds.

Now [illegible] admitting that habitually one [illegible] by itself, I am prepared to [illegible] acts can be performed at the [illegible] shown what is necessary for the [illegible] of volition, and that these [illegible] attention.

[illegible]

[illegible] augmented, and meetings were held and lectures [illegible] and dissemination of scientific [illegible]

[illegible] during the troubled years which [illegible] more commodious quarters [illegible] in 1826 the Academy moved to a building which had [illegible] for its reception, where two years later [illegible] its museum, entrance to which, [illegible] years, or up to 1870, was free [illegible] week. In 1840 the museum [illegible] to a building which had been [illegible] at the cost of several [illegible] Yet again in 1876 a further [illegible] building, which is built [illegible] as are also many other public [illegible] style of the architecture [illegible] building and the valuable collections [illegible] existence at the present day [illegible] and gratuitous labour of persons [illegible]

[illegible] Academy are varied, owing to the [illegible] Its leading character [illegible] "It is scientific because [illegible] the extent of its ability, and [illegible] may discover for the information [illegible] are made up entirely of [illegible] research.

[illegible] gratuitous instruction [illegible] and opens its library freely [illegible]

[illegible] to increase the [illegible] by granting a Museum [illegible]

[illegible] have been modified [illegible] establishment of Professorships [illegible] support shall be made [illegible] remunerated, and [illegible] which may yield from [illegible]

[illegible] works on zoology and [illegible] collection of [illegible] and the collection of [illegible] which have been largely [illegible] Academy itself is very [illegible] 25,000 [illegible] considerable additions have [illegible]

[illegible] of the Academy, the [illegible] Dr. Leidy, who is assisted [illegible] arrangement, owing [illegible] of the cases, which [illegible] funds, does not [illegible] arrangement; but the [illegible] well known to many [illegible] largely of types [illegible] described. Here, for [illegible] famous [illegible] of [illegible], and Dr. [illegible] Among these [illegible] of which [illegible] in the main gallery [illegible] these kangaroo- [illegible] when Dr. Leidy [illegible] The [illegible] in the world, [illegible] already mentioned, [illegible] the new [illegible] in the New York [illegible] of shells which [illegible] renowned for its extent [illegible]

[illegible] authorities to be one [illegible] United States. In 1876 [illegible] It was com- [illegible] many private [illegible] by their owners [illegible] of the Academy. [illegible] there is a special one [illegible] Vaux, who also left a [illegible] fund for the payment [illegible]

contribution to the [illegible] in the higher mammals, by Fr. [illegible] [illegible] by A. [illegible] [illegible] [illegible] by A. [illegible]

*[illegible]*, July 9.—Principles of criminal law, preventive measures and police [illegible], [illegible] [illegible] [illegible] by Prof. J. [illegible] [illegible] by Prof. [illegible] [illegible]

## SOCIETIES AND ACADEMIES

[illegible]

**Royal Society,** July [illegible] [illegible]

[illegible]

[illegible]

**Academy of Sciences,** [illegible]

[illegible] by MM. C. Vincent and J. Chappuis [illegible]

[illegible] by M. Ch. Tellier.

## CONTENTS

Printed ... in the City of London, and Published by ... Bedford Street, Covent Garden.—Thursday, August 20, 1885.


A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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

No. 826, Vol. 32] THURSDAY, AUGUST 27, 1885 [PRICE SIXPENCE

Registered as a Newspaper at the General Post Office]

## CITY AND GUILDS OF LONDON INSTITUTE

FOR THE ADVANCEMENT OF TECHNICAL EDUCATION

[illegible]

## CITY AND GUILDS OF LONDON INSTITUTE.

CENTRAL INSTITUTION, EXHIBITION ROAD, S.W.

[illegible]

## CITY AND GUILDS OF LONDON INSTITUTE

[illegible]

## CITY AND GUILDS OF LONDON INSTITUTE.

[illegible]

## CITY AND GUILDS OF LONDON INSTITUTE

[illegible]

## CITY AND GUILDS OF LONDON INSTITUTE

[illegible]

## THE MASON COLLEGE, BIRMINGHAM

[illegible]

A B.A. SCHOLAR OF ST JOHN'S CAMB

[illegible]

## LIVING SPECIMENS FOR THE MICROSCOPE

GOLD MEDAL awarded at the FISHERIES EXHIBITION,

THOMAS BOLTON, 17, NEWHALL STREET, BIRMINGHAM

[illegible]

Specimen Tube, One Shilling, post free.

[illegible]

## NORMAL SCHOOL OF SCIENCE AND ROYAL SCHOOL OF MINES.

SOUTH KENSINGTON AND JERMYN STREET

[illegible]

## BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

[illegible]

T. G. BONNEY, Secretary

## ST THOMAS'S HOSPITAL MEDICAL SCHOOL.

[illegible]

W. M. ORD, Dean

THURSDAY, AUGUST 27, 1885

## THE LIFE OF FRANK BUCKLAND

*Life of Frank Buckland.* By his Brother-in-Law, George Bompas. (London: Smith, Elder, and Co., 1885.)

FEW Englishmen were unacquainted with the central figure of this admirably written memoir. His ubiquity as a lecturer and inspector, the happy self-forgetfulness and adaptability of manner which associated him with royal princes as readily as with seaside fishermen, and the strong personality by which he permanently impressed all who came in contact with him, made him beyond all other men of his time the representative and the preacher of the subject to which he devoted all the energies of his life. That subject was natural history, a term not without meaning even in the present day of minute and subdivided scientific work, but conterminous with science half a century ago, when comparative anatomy was hardly known, when the microscope was costly and imperfect, when the provinces of nature had not been mapped nor its workers differentiated.

Frank Buckland was born a naturalist, into a home crammed with animals, living, preserved, fossil; his mother a woman of rare intellectual accomplishment and scientific taste, his father the first geologist of the age. At three years old he could "go through all the natural history books in the Radcliffe Library"; at four we find him lispingly explaining to a Devonshire parson who had brought with pride to Dr. Buckland "some very curious fossils," that they were the vertebræ of an Ichthyosaurus; at five he is rapturous over the teleology of the "tongue-bone" in the skeleton of a whale; and in the archæology of Worcester Cathedral can find only one object of interest—the figure of a lady who had been starved by a disease in the throat.

At twelve he went to Winchester, not the least barbarous school of that barbarous scholastic time. He was "launched," and "tin-gloved," and "toe-fit-tied," and "tunded," and "clowed," and "watched out" at cricket, and "kicked in" at foot-ball, living for two or three years the wretched life of a college junior amid a mob of boys not overlooked by any master and influenced by the bad traditions of a savage past. He used to say that it had done him good, had cured him of "bumptiousness" and arrogance, but he cherished painful memories of individual tyrants and of special acts of tyranny, and was wont when a senior boy to criticise with a bitterness alien from the ordinary conservatism of schoolboys the coarseness of a system which turned a gentleman's son, bred in the refinement of a cultured home, into an abject domestic serf.

Buckland's fagging days over, he was happy, for he could follow his bent undisturbed, and the pages which describe his later Winchester life are amongst the most amusing in the biography. Fond of school work he was not; he was, in fact, looked upon as a "thick," and his compulsory fagging experiences had given him a dislike for games. But he wired trout and eels in the clear Itchen streams, dug out mice on "Hills," chased badgers on Twyford Down, skinned and dissected cats, moles, and bats, articulated skeletons, baked squirrel pies, and cooked mice in batter. A buzzard, an owl, and a racoon tenanted his lockers in "Moab," a viper lived in his "scob" amongst his books, his hedgehogs kept open a perpetual fosse at the base of the college wall, and a regiment of tame jackdaws looked up to him as their patron. On "Saints' days" he attended the Winchester Hospital, bringing back gruesome fragments of humanity in his pocket-handkerchief, talked medical language, treated confiding boys professionally. Applying for admission to the sick house on behalf of a patient who had partaken too generously of "husked gooseberry fool," he informed the surprised second master that the invalid had a "stricture of the colon;" he was wont to offer sixpence to any junior who would allow himself to be bled; and he treated surgically a football-wounded shin with such results that the leg when shown eventually to a doctor was pronounced to be in imminent danger of amputation.

The Winchester life found fuller development at Oxford. No one who knew Frank Buckland there will forget those merry breakfasts in the corner of Fell's Buildings; Frank in the blue pea-jacket and the German student's cap, blowing blasts out of a tremendous wooden cow-horn; the various pets who made it difficult to speak or move: the marmots, and the dove, and the monkey, and the chamæleon, and the snakes, and the guinea-pigs, and the after-breakfast visits to the eagle or the jackal or the bear or the pariah dog in the little yard outside. His Long Vacations were spent in Germany, whence he brought back little besides collections of red slugs and green frogs; in 1848 he entered at St. George's Hospital, and in 1854 was gazetted Assistant-Surgeon to the second Life Guards.

The next eight years were very pleasant ones. His father's position as Dean of Westminster threw open to him all the best society in London: we read of parties at Miss Burdett-Coutts's, at the Duke of Wellington's, at Chief Baron Pollock's; microscopic evenings at Dr. Carpenter's; walks around the Abbey with Prince Albert; conversations with Sir B. Brodie, Mr. Gladstone, Whewell, Whately, Prof. Owen, Sedgwick, Bunsen, Ruskin. He was beginning to feel his strength and strike out his line in life; in these years he wrote his first magazine article, delivered his first lecture, published his first book. In 1865 he resigned his commission, married, took the house in Albany Street which he has made historic, started *Land and Water*, devoted himself to fish culture, became Inspector of Fisheries, and worked in his vocation till 1880, when he died at the age of fifty-four, worn out by excessive overwork and by the exposure to wet and cold in all seasons which his professional duties, as he interpreted them, involved.

His power as a lecturer was unrivalled. He could keep an audience in ecstasies of laughing enjoyment for two hours at a stretch. He had inherited his father's remarkable felicity of illustration; his own keen delight in his subject was contagious, his comedy incessant and irresistible. Never was a memory more stored with interesting facts. He was all eyes; noted everything, remembered everything, used everything. Through London stree[ts] as he surveyed them from his favourite seat on the k[nife] board of an omnibus, on the walls of exhibitions, on coose, three shoes [illegible] of the belfry [illegible], by Dean [illegible] which [illegible] overlooked or passed [illegible] were by him preserved [illegible] and analysed [illegible] fruit [illegible] and correlation [illegible] and purpose of scientific use. [illegible] department he was the recognised [illegible]. Miss Swann the giantess [illegible] the giant, and the Two-headed [illegible] the Siamese Twins, and the [illegible] and John [illegible] Benedetti the [illegible] of the Wood, and [illegible] all [illegible] his table. He [illegible]

[illegible]

swordfish, [illegible]

[illegible]

John Hunter, [illegible]

[illegible]

of tripang and [illegible] stewed whelks and [illegible]. We notice in [illegible]

the diary such entries as "seedy from lump-fish;" "[illegible] poorly [illegible] feed, efforts of horse;" and we sympathise with a departing guest who notes—"tripe for dinner—don't like [illegible] for breakfast."

He was the Samson of science: the "Sunny One" amongst [illegible], as was Manoah's son amongst [illegible]; notes of genial laughter accompany the [illegible] and the feats of both. But the comic recollections which surround him ought not to mask the serious admiration which is his due—first, as a public teacher, circulating popular science, generating field clubs and microscopical societies, preparing a public to appreciate and to support the more purely scientific labourer; secondly, as [illegible] national benefactor, raising in fifteen years the commercial value of English and Scottish salmon to the extent of [illegible] per annum; thirdly, as having [illegible] manner rare [illegible], passed behind the veil which hangs between us and the animal creation. He understood their gestures and expressions as we interpret those of one another, and they understood him in their turn. [illegible] at the Gardens, the beasts at Jamrach's [illegible] home, seemed to know him in a human fashion [illegible] words: "God is so good to the little fishes [illegible] think He will let their inspector suffer [illegible] show his identity of feeling with them [illegible] without a strangely [illegible] brotherhood with these [illegible] fraternal as people of his Father's [illegible] his Father's hand. Science has had [illegible] none more simple, [illegible] none more genial, more humane, [illegible] beloved.

W. T[illegible]

## [illegible] COMPASSES

*[illegible] of Compasses [illegible]* By Lieut. Collet, French Navy, [illegible] School of France. Translated [illegible] With a Preface by Sir W. Thomson [illegible] and Co., 188[illegible]

THIS [illegible] English garb under the [illegible] W. Thomson [illegible] for the adjustment of [illegible] W. Thomson gives short [illegible] of the deflector an instrument to [illegible] by magnets and [illegible] terrestrial objects [illegible] fog is not the [illegible] with the fog there [illegible] favourable to a successful [illegible] W. Thomson. It is certain that [illegible] deflector will at once [illegible] theoretically correct [illegible] refinement in construction. The [illegible] the practical applications [illegible] has, however, been left [illegible] connected with the compass [illegible] the French Navy—and [illegible]

It may be remarked that Sir W. Thomson, in the preface, fully recognises it as a complete and able exposition

correct name, nor far where [illegible] information about it.

It can thus be well understood [illegible] who never had the good fortune to know Forbes, that the loss of such a man was keenly felt by his numerous friends and fellow-workers. Soon after his death, in 1855, it was resolved, at a meeting of the Zoological Club, that some sort of memorial of him should be carried out. After due consideration of the question it was unanimously determined by the Committee to which the subject was referred that the best scheme would be the republication of Forbes's numerous papers in a connected form. This had been the course adopted [illegible] of Garrod, who had preceded Forbes in the Prosectorship of the Zoological Society of London. It was found that Forbes's contributions to science would make a volume of about the same size as the scientific papers of Garrod, and would not, it was believed, be of inferior interest.

The memorial volume, prepared and issued under these circumstances, contains [illegible] papers published by Forbes in different periodicals from 1875 to 1882. The original illustrations have been in every case reproduced, and to increase the usefulness of the reprint, exact references to the paging of the original articles are added in the margin. At the end of the volume is given Forbes' last journal, reprinted from the *Ibis* for 1883, and containing a most interesting account of his doings during his fatal expedition up the Niger. Forbes died at Shonga, one of the stations of the United African Company on that malarious river, on January 14, 1883. Up to two days before his death the entries in the journal are in his own writing. The fatal termination of his illness, recorded by another hand, concludes the volume.

## OUR BOOK SHELF

*Elementary Algebra for Schools.* By H. S. Hall, B.A., and S. R. Knight, B.A. (Macmillan, 1885.)

This is, in our opinion, the best elementary Algebra for school use. It is the combined work of two teachers who have had considerable experience of actual school teaching, aided by the advice of such men as the present Head of Clifton College, and so successfully grapples with difficulties which our present text-books in use, from their authors lacking such experience, ignore or slightly touch upon. Up to the point to which the subject is carried in this volume, it is treated with sufficient completeness for ordinary school purposes: the last four chapters present a somewhat [illegible] progressive [illegible], however, [illegible] enough ground for the ordinary examinations which [illegible] on earlier. The authors propose to treat these parts in fuller detail in a *Higher Algebra*, which they are preparing. We do not propose to examine the book at any length, but confidently recommend it to mathematical teachers, who, we feel sure, will find it the best book of its kind for teaching purposes. Many subjects of interest are also treated of, and a vast collection of [illegible] examples are furnished amply exercise for the boys, and save the teacher the trouble of [illegible] the best methods. Answers are furnished at the end, so that those teachers who do not care that the pupils should have them handy, may have them torn up.

*Key to the Elements of Euclid.* By J. S. Mackay, M.A. (W. and R. Chambers, 1885.)

This is a most valuable pendant to the edition of the "Elements" which we recently had occasion to notice so favourably. It is a book of nearly the same size as the "Elements" and yet contains, in consequence of the general omission of diagrams, solutions of the very large collection of admirable deductions which Mr. Mackay collected for the student in that work. De Morgan's words, quoted in the short preface, furnish ample ground for the omission of figures: "I am satisfied, from sufficient trial, that when proper description of the diagram is given in the text, the person who draws his own diagram from the text will arrive at the author's meaning in half the time which is employed by another to whom the successive appearance of the parts is presented by his [illegible] the whole from the beginning."

*The Essentials of Histology.* By E. A. Schäfer. (London: Longmans, Green and Co., 1885.)

This will prove a useful book for students. It is arranged in forty-two lessons and appendix. Each lesson commences with a short statement of methods for the microscopic examination of the tissue described in the lesson. All simple tissues and organs are then passed in review, and their most essential characters are [illegible] described and illustrated. It is to be regretted that Prof. Schäfer has deviated from the customary plan of giving some kind of reference both for the text and the illustrations. The latter are mostly taken from Prof. Schäfer's portion of Quain's Anatomy, and their original source, although mentioned in Quain's, is here omitted.

An index at the end of the book would be a desirable addition.

E. Klein

*The Atlas of Practical Elementary Biology.* By G. B. Howes. (London: Macmillan, 1885.)

The anatomical drawings of Mr. Howes have for some time been well known in all laboratories where animal morphology is taught. In his "Atlas of Elementary Biology" he has now published a very complete series of figures illustrating the chief of those animal and vegetable types which are generally given to students in their first session. The need for such a work as this is well known to every one who has any experience of biological teaching, and the name of its author is a sufficient guarantee of the careful accuracy and artistic excellence of the drawings it contains. The low price at which a student's text-book must necessarily be sold has precluded the use of colour, which might in a few cases have given some additional clearness to the figures, but all that could be done with black and white has been done, and every figure is evidently a faithful copy of an actual dissection, such as a student may reasonably hope to repeat for himself.

In the case of every animal chosen, a series of drawings showing the gross anatomy of the adult is followed by a few illustrations of the minute structure of its tissues and of its main developmental features.

The drawings of adult anatomy are throughout excellent; the others, though the size of the work has somewhat restricted their number, will probably suffice for most of the needs of [illegible] students. It is however to be regretted that there is no figure showing the minute structure of the [illegible] in Amphioxus, and also that Mr. Howes has not been able to accept Spencer's statement as to the [illegible] of the frog's blastopore into the permanent anus.

The botanical portion of the Atlas contains an admirable series of figures showing the structure of the plants described in Huxley and Martin's well known text-book, and completes a work which cannot fail to be of the greatest service both to teachers and to students of biology.

W. F. R. W.

and Heat

Pulsati[illegible] Vein

[illegible]

[illegible] mixed up with an indefinite movement of th[illegible] [illegible] general unsteadiness. The mirrors should [illegible] [illegible] inch square or thereabouts. The silvering [illegible] [illegible] detached from the glass by adhesion to the [illegible] the glutinous substance is applied directly to the back of [illegible] [illegible] back and edges should be covered [illegible] gummed paper (such as the margin of a sheet [illegible] postage stamps) [illegible]. This protects the silvering, so that [illegible] [illegible] may be used repeatedly, and their position changed [illegible] [illegible] required; whereas without this precaution [illegible] [illegible] on the first application. Any sticky glutinous [illegible] which does not dry readily (such as indiarubber [illegible] [illegible] naphtha) is convenient, because by its use [illegible] [illegible] with the least trouble shifted from one spot to [illegible], in the search for a place where the venous pulsation [illegible] [illegible], and this will not always be found [illegible] [illegible] the appearance of the veins it might be expected [illegible]

J. H[illegible]

[illegible] Bath, August [illegible]

## The Fauna of the Sea Shore

In the [illegible] correspondence in NATURE on the "fauna of the [illegible]" [illegible] has arisen in the use of the [illegible]

[illegible] Prof. Moseley, on whose lecture I [illegible] [illegible] the word in the extended sense of denoting [illegible] "deep-sea" [illegible] "pelagic." Mr. Hughes, on the [illegible] it in its common acceptation as [illegible] between tide marks.

[illegible] disturbed by waves to a [illegible] to describe it. It is not [illegible] [illegible] will not cover [illegible] for instance, [illegible] both [illegible] strongly on the [illegible] might be used to describe [illegible] can sensibly affect the [illegible]

[illegible] has not, I believe, [illegible] oscillating waves [illegible] seems to approach the [illegible] according to the evidence [illegible] make themselves felt [illegible]

[illegible] Mr. R. A. [illegible] map of the English [illegible] the following deposits [illegible]

[illegible] with fragments of *[illegible]*

[illegible] with fragments of *[illegible]*

[illegible] gravel with decayed *[illegible]*

[illegible] fine gravel, [illegible]

[illegible]

[illegible] shells (in upwards of [illegible]) [illegible] Bank, [illegible]

[illegible]

[illegible] to decay, [illegible]

[illegible]

[illegible] storm-engendered [illegible] the [illegible] extent. But [illegible]

Solar ...

Mathematical Theory ...

brought from Japan by their intelligent collector Mr. C. Maries.

M. Carrière states, in an editorial note to Count Castillon's article, that the plant had been introduced into France at that date, and was indeed actually on sale in the nurseries near Antibes.

Nothing, however, till quite recently, appears to have been known as to the existence of the square bamboo in China, from which country, however, it is extremely probable that the Japanese procured it. Thus, Mr. F. B. Forbes, whose personal knowledge of the Chinese flora is only second, perhaps, to that of Dr. Hance, informs me:— "I have never seen the square bamboo growing, and I have always supposed that its 'squarity' was artificially produced."

The first authentic account of its occurrence in China is, as far as I know, due to Mr. Frederick S. A. Bourne, of H.B.M. Chinese Consular Service. Mr. Bourne wrote to us, [illegible] that he had made a journey from Foochow [illegible] of [illegible] to the western border of the [illegible] province, reaching Wu [illegible], the celebrated [illegible] the Bohea hills, a place, Mr. Bourne states, [illegible] by a European once before, I believe [illegible] Mr. Fortune, about the year 18[illegible]. In the gardens of [illegible] monastery he found several clumps of the square bamboo growing to the height of [illegible] feet.

The *Imperial Agri-horticultural* [illegible] astonishing repertory of everything relating to the economic botany of the East, contains in its issue for November, 188[illegible] (p. 445), an article extracted from the [illegible] *Herald* also relating to the square bamboo, plants of which, destined for the park at San Francisco, have been obtained by Dr. Macgowan at Wenchow. [illegible] from this article the following particulars, which show the interest the Chinese themselves attach to the plant:—

"Pre-eminence is accorded to the square [illegible] of this most useful as well as ornamental plant, which has been a favourite in Imperial gardens whenever [illegible] has been effected in the south. The Emperor [illegible] once inquired of his attendants, who were planting bamboos, concerning the [illegible] kinds [illegible] formed concerning several remarkable species [illegible] in particular furnished one that was an extraordinary curiosity, in that it was square, and for that reason and its perfect straightness was much esteemed [illegible] scholar. They [illegible] told him that it was used for many purposes of the canon [illegible] rulers, [illegible] among others that of being [illegible]. Subsequently specimens were obtained, [illegible] and sent to his majesty, who thereupon [illegible] his respect for the article by rubbing ink with [illegible] on the inkstand, and inditing an essay on the [illegible]. In 1[illegible] the reigning Emperor sent a [illegible] specimens for the [illegible] park. [illegible] from [illegible] of the province, it is found in [illegible], Sec[illegible], [illegible] and [illegible] in the latter province it appears [illegible] in a marked degree [illegible], and as well defined as if [illegible] knife. [illegible] have slightly rounded [illegible] and [illegible] are more slender, [illegible] used only [illegible] pipe-stems, whereas the western kind [illegible] enough to serve [illegible] staves for the aged. In its early [illegible] the square bamboo is nearly round, [illegible] presents [illegible] as it advances towards maturity. Like several other kinds of [illegible] thorny, abounding in small spines."

Dr. Macgowan being well known to botanists for his intelligent interest in all that relates to the vegetable productions of China, I ventured to write to him to ask his aid in procuring living specimens of this interesting plant for the Royal Gardens. Through his kindness and that of Mr. E. H. Parker, the acting consul at Wenchow, we were fortunate enough to receive a Wardian case filled with plants of the square bamboo, some of which at least appeared to be alive and likely to grow. Besides these Dr. Macgowan sent us specimens of walking-sticks and pipe-stems made from it.

I quote the following passages from the very interesting communication with which Dr. Macgowan was also good enough to favour us:—

"Its geographical range is from 25° to 30° N. latitude, littoral, and westward farther than I have been able to discover. Unlike other varieties of bamboo here, its shoots are developed in the autumn, not in the spring. It sprouts in September or October, and the stems grow until they are arrested by December cold, by which time they attain a height of from two to four or five feet. In the spring following their growth recommences, when the grass attains its full height, ten to fourteen feet. The lower portion of the culms bristle with short spines. In the second or third year their squareness is far less striking than when matured by several years' growth; that quality is sometimes so marked that a native botanist describes them as appearing like rods pared by cutting instruments. I have seldom found the corners much more sharply defined than in the largest of the specimens herewith transmitted. It is cultivated chiefly for ornament in gardens, in temple courts, &c.; the larger stems, sometimes as much as an inch and a half through, are used for staves; the smaller and less squarish for stems of opium-pipes; and the smallest and less mature for [illegible] pipes."

He further adds:—"Its anomalousness is attributed by the Chinese to supernatural powers—occult agencies varying with each district. The *Ningpo Gazetteer* [illegible] [illegible] Ko Hung, the most famous of alchemists, [illegible] [illegible], thrust his chopsticks (slender bamboo rods) pared square into the ground of the spiritual mountain [illegible], which, by thaumaturgical art, he caused to take root and to appear as a new variety of bamboo—square."

As no flowering specimens of the square bamboo have reached the hands of botanists, its taxonomic position must at present be regarded as doubtful. Rivière ("Les Bambous," p. 31[illegible]) refers to it as the *Bambou carré*, and Fenzi, quoting from Rivière (*Bull. Soc. Tosc. di Ort.*, 18[illegible], p. [illegible]) gives it the name *Bambusa quadrangularis*.

I can discover no reference to it in the late General Munro's classical monograph of the *Bambusaceae* (*Trans. Linn. Soc.* vol. xxvi.). Of the three groups into which he divides the genera, in only one, *Triglossae*, is there any tendency to depart from the habit of the order in having anything but round stems; and this only occurs in the small genus *Phyllostachys*, in which they are somewhat [illegible] flattened. The stems of *Phyllostachys nigra* [illegible] often used in Europe for walking-sticks and [illegible] [illegible] handles.

But I do not think the square bamboo will turn out to be a *Phyllostachys*. Munro has a *Bambusa angulata* which is distinguished from all its allies by having the branches of the panicle angular. This is the only tendency to angularity of stem which I have discovered among the true *Bambuseae*.

For the present, at any rate, the species must be known provisionally as *Bambusa quadrangularis*, Fenzi.

W. T. THISELTON DYER

## FORECASTING BY MEANS OF WEATHER CHARTS

THE Meteorological Office has issued a work on the "Principles of Forecasting by Means of Weather Charts," which has been prepared at the request of the Council by the Hon. Ralph Abercromby.[1] The object of

[1] "Principles of Forecasting by Means of Weather Charts." By the Hon. Ralph Abercromby, F.R.Met.S. [illegible] Issued by the Authority of the Meteorological [illegible] London, 188[illegible].

instead of a low one, as [illegible] the case of the V's. The wedges seem to shoot up in front of cyclones and V depressions and to travel along before them. [illegible] the front, or east side, the weather is very bright, and the wind [illegible] north-west and moderate, while the temperature is that due to excessive radiation. On the rear, or west side, where the barometer begins to fall, the wind turns to south-west, and the sky overcasts in that peculiar manner which first gives a halo, and then gradually becomes black, without true cloud as the cyclone approaches. At the extreme north point of the wedge a shower or thunderstorm is sometimes observed.

*Straight Isobars.*—In these the pressure is high on one side and low on the other without any definite cyclone, the isobars running straight across the slope which joins the regions of high and low pressure. Straight isobars are never persistent, and the area which they have occupied is usually traversed by a cyclone of greater or less intensity. For forecasting purposes the indications are but [illegible] cold, cloudy, unsettled weather, the wind from moderate to fresh, according to the gradients, to be followed soon by rain, as a [illegible] forms or comes up.

*Col.* The [illegible] of a neck of low pressure between two anticyclones. The winds are light and the weather [illegible] variable in appearance, owing to the local influence of [illegible]. Though the general position [illegible] the weather is rather variable, owing to the tendency of the depression which lies on the north-west to develop a secondary in the col. Hence [illegible] forecasting, though it is possible to tell what the weather would be in the col at any moment, the future course of the weather is subject to much uncertainty.

Mr. Abercromby devotes a considerable portion of his work to a discussion of weather types and sequences. With reference to Western Europe, there are at least four well-marked types of weather. [illegible] an anticyclone lies to the [illegible] Britain, while cyclones coming in from the Atlantic either beat up against the [illegible] the north-east. [illegible] Westerly, in which the typical belt of [illegible] found to the south of Great Britain, [illegible] which are borne [illegible] Atlantic pass [illegible] east or north-east. [illegible] The Northerly [illegible] Atlantic [illegible] west of Great Britain [illegible] In this case [illegible] and [illegible] or less [illegible] appears [illegible] beyond the [illegible] cyclones [illegible] south [illegible] cyclones, or else their progress [illegible] arrested or deflected by the [illegible] east of Europe [illegible] of the north-east [illegible] the east [illegible]

Mr. Abercromby [illegible] in forecasting [illegible] careful and [illegible]

In concluding [illegible] work, Mr. Abercromby gives [illegible] remarks on forecasting generally. [illegible] many cases of small disturbances the minor features are so local that it is only the general character of the weather which can ever be forecast. Owing to the general nature of all meteorological changes, forecasts can never be issued very long in advance. The British forecaster labours under peculiar difficulties from his geographical position. Situated on the most exposed [illegible] and in the [illegible] which almost always advance from the westward, he has no intimation of an approaching cyclone till it is actually on him. Mr. Abercromby's opinion is that, however carefully the relation of weather to isobars may be defined and the nature of the changes described, the judgment which experience alone can give to enable a warning to be issued must ever depend on the professional skill of the forecaster.

## RADIANT LIGHT AND HEAT[1]

### II.

### *The Theory of Exchanges*

IT was known at a comparatively early period that if a body be placed in an enclosure of constant and uniform temperature, it will ultimately attain the temperature of this enclosure.

To fix our ideas, let us suppose that we have a chamber surrounded on all sides by walls which are kept at the temperature of boiling water (100° C.), and let us further suppose for the sake of simplicity that there is no air in this chamber, so that no heat can be carried about by movable particles of gas. If under these circumstances we put a [illegible] into the chamber, it will ultimately reach [illegible] temperature it will remain. This is [illegible] of the doctrine of temperature equilibrium [illegible] equilibrium may be of two kinds—for it may either be [illegible] equilibrium, in virtue of which two bodies at the same temperature cease to radiate to each other, or [illegible] a dynamical equilibrium, in virtue of which each of these bodies independently radiates heat to its neighbour, receiving back, however, just as much heat as it gives out. In either case the ultimate result will be equality of temperature, and the only difference will be in the physical machinery by which the result is brought about. In the theory of statical equilibrium the behaviour of two bodies of equal temperature with respect to [illegible] may be compared to that of a man with respect to money [illegible] neither richer nor poorer, because he is [illegible] giving away and receiving any money, whereas in the theory of dynamical or movable equilibrium [illegible] with the man who is getting [illegible] because he is receiving back just [illegible] as he is giving out.

[illegible] conversant with frequent [illegible] of the latter class, but the [illegible] would [illegible] that we cannot [illegible] and similar [illegible] that if radiant light [illegible] kind of energy, the theory of a [illegible] must be much more [illegible] than that of a statical [illegible] Historically, however, the [illegible] equilibrium was not decided [illegible] conceptions of which [illegible] to be of much service [illegible] the discussion.

[illegible] theoretical and practical [illegible] to give a short account of [illegible] the origin and development [illegible] as the *Theory of heat* [illegible] Prof. Pictet of Geneva [illegible] experiment.—He took two concave [illegible] the ordinary mode of [illegible] mixture in the focus of [illegible] that of the other, upon [illegible] the thermometer was observed [illegible] be explained if we [illegible] a substantial entity capable of [illegible] reflection like heat. But it was in [illegible] Pierre Prévost, also of Geneva, [illegible] for the explanation of this [illegible] movable equilibrium of heat.

It [illegible] that [illegible] a theory will explain the [illegible]

the temperature of 100° C. The inside we shall suppose to be a vacuum. Let us in the first place hang up in this chamber two thermometers, one covered on the outside of its bulb with lamp-black, the other with polished silver. The former of these will absorb all the rays that fall upon it from the walls of the chamber, the latter, on the other hand, will absorb very few of these rays. Ultimately, however, both thermometers will attain the temperature of the walls. Since, therefore, according to the theory of exchanges the equilibrium of temperature is kept up by an equality of absorption and radiation, it is manifest that the radiation from the lamp-black thermometer must be great, because the absorption is great, and the radiation from the silvered thermometer small, because the absorption is small.

It will be noticed that this connexion between the two qualities, absorption and radiation, is deduced from a hypothetical case where everything is at a constant temperature. To prove it experimentally we may without any breach of scientific propriety take out the two thermometers from the enclosure, exposing them to a lower temperature, and noticing their velocity of cooling, when it will be found that the blackened thermometer cools more rapidly than the silvered one.

Or we may allow their radiation to fall upon a thermopile, and to be registered by a galvanometer, when it will be found that the indication of the galvanometer will be much greater for the blackened than for the silvered thermometer.

Let us next hang up in our enclosure a plate of glass and one of polished rock-salt.

The plate of glass will absorb all or nearly all the rays of dark heat that fall upon it from the sides of the enclosure. The plate of rock-salt will, on the other hand, absorb only a few of these rays. A similar argument to that already given will enable us to see that if the theory of exchanges be true the radiation from a plate of rock-salt must be decidedly less than from one of glass, and this is found to be the case.

Next, let us hang up two plates of rock-salt, a thick one and a thin one. The thick one will absorb more rays than the thin one, and we shall therefore expect it to radiate more. This, too, will be found to hold experimentally, thus proving the fact of internal radiation. On the other hand, we shall observe no sensible difference if we hang up two plates of glass, one thick and one thin, the reason being that the thin plate of glass already absorbs all the heat which falls upon it, so that no increment of absorption, and hence of radiation, can take place by increasing the thickness. We thus see that it is only in the case of diathermanous bodies that the radiation increases with the thickness, while for athermanous bodies there is no such increase.

We are now in a better position for realising what takes place in our hypothetical enclosure.

There is a stream of heat from the walls which falls upon any substance which we may introduce into our chamber. Now this stream is not altered in intensity by altering either the shape or substance of the walls. Suppose, for instance, that they are of polished metal instead of being covered with lamp-black, then, while the heat radiated from them will be less, the reflection of this heat will be redoubled backwards and forwards between the walls as to swell up the total amount to an equality with the lamp-black radiation, the only difference being that in the lamp-black radiation there is little or no reflection, while in the other there is much reflexion and comparatively little radiation. Nor will the stream from the walls be altered by hanging up a plate of any substance between them and the body we introduce. For the plate will radiate on its own account just as much heat as it absorbs from the walls, so that the joint radiation of the two will be the same as if the plate were taken away.

Our remarks have hitherto applied only to the total intensity of this stream of radiant heat, and not to its quality; that is to say we have left out of consideration the specific mixture of various kinds of rays differing either in wave-length or in polarisation which go to make up the whole heterogeneous radiation. Now a little reflection will convince us that this specific mixture—the *quality* of the radiation stream—must, as well as the *quantity* remain the same under any change made in the shape or substance of the enclosure. For suppose that we introduce a thermometer coated with some substance which exercises a selective absorption for certain rays of the stream, and not for others, then a change of quality would mean for this thermometer a change of absorption as truly as if there were a change of quantity. But by the theory of exchanges the absorption must remain the same, being equal to the radiation, and hence this can only be brought about by the quantity and the quality of the radiation stream remaining each unaltered whatever change be made in the walls of the enclosure, or whatever substance be introduced between these walls and the thermometer. Carrying out this train of thought, we see why, as was proved by Provostaye and Desains, the sum of the radiated and reflected heat from any portion of the walls must be unpolarised, the reason being that the radiated heat from lamp-black is unpolarised and the one radiation must be equal to the other not only in quantity but in quality also. Again, the radiation of any surface or of any plate must be equal to its absorption, both as regards quantity and quality, so that the stream of heat may emerge from the surface or from the plate unaltered both in quantity and in quality.

Thus the putting up of a plate between the walls and our coated thermometer will produce no effect, inasmuch as the stream of radiant heat which falls upon the coating will be unaltered both in quantity and quality by the interposition of the plate. We thus see why the radiation from a thin plate of rock-salt should be of a quality which renders it much absorbed by a cold plate of the same material, the reason being that a body radiates that kind of heat which it absorbs.

We see, too, why heat from a thin plate of rock-salt should be more absorbed by a cold screen of this material than that from a thick plate, inasmuch as the former consists of that kind of heat which is strongly absorbed by a thin plate, while the latter contains likewise a number of other rays which are not so strongly absorbed.

The conclusion to be derived from these remarks is that we have in reality a separate equilibrium for every description of heat, an equilibrium which is independent of the shape of the enclosure and of the substances of which it is composed. Furthermore, the stream of radiant heat may be supposed to circulate in the interior of a substance such as glass, water, or even metal, the radiation of each particle which it meets being exactly equal to its absorption, so that the stream proceeds through the interior, being virtually the same at one part of its path as at another. Again, it can be shown that it is essential to equilibrium that in the interior of a substance the stream of heat should be proportional to the *square of the refractive index*. That is to say, in an enclosure containing glass whose refractive index is 1·5 the stream of radiant heat in the heart of the glass will be 2·25 times greater than that proceeding through a vacuum. We cannot, however, tell what takes place in the heart of a crystal. It thus appears that, for an enclosure of given temperature, the stream of a given kind of heat has a definite value, the amount of this increasing as the temperature increases.

We are, however, ignorant of the exact function of the temperature which expresses the value of this stream, but we know that this value increases more rapidly for the more refrangible rays of the spectrum than for those of greater wave-length and smaller refrangibility.

We now come to consider the luminous rays, and here the wondrous power of the eye can aid us to an extent far surpassing that of the most delicate pile and galvanometer for the dark rays.

Wollaston and Fraunhofer were the first to show that in the solar spectrum numerous dark bands occur, which indicate the absence of certain definite kinds of light.

Sir David Brewster afterwards showed that similar bands make their appearance when the spectrum is made to pass through nitrous acid gas, and it was thus rendered probable that the bands which appear in the solar spectrum were due to absorption likewise.

Brewster, J. Herschel, Talbot, Wheatstone, and W. A. Miller were amongst the first to make observations upon the luminous spectrum obtained by heating various substances, and it was soon perceived that such spectra consist of bright lines on a dark background, and thus appear to be a reversal of the solar spectrum, which consists of dark lines on a bright background. Fraunhofer was the first to notice a coincidence in spectral position between the dark double line D occurring in the solar spectrum and the bright yellow flame produced by incandescent sodium. Swan afterwards showed that the correspondence between the two black lines and the two bright lines is very exact, and that a very small quantity of salt is sufficient to call forth the bright lines. Ångström (*Phil. Mag.*, May, 1855), referring to a conjecture of Euler that a body absorbs all the series of oscillations which it can itself assume, expresses his conviction that the same body, when heated so as to become luminous, must emit the very rays which at ordinary temperatures are absorbed, and that the explanation of the dark lines in the solar spectrum embraces that of luminous lines in the electric spectrum. Probably, however, the first to give definite expression to this conception was Prof. Stokes, who, about the year 1850, commented on an experiment recently made by Foucault. This observer had found that, when a voltaic arc formed between charcoal poles was placed in the path of a beam of solar light, the double line D is thereby rendered considerably darker. If, on the other hand, the sun and the arc jut out the one beyond the other, the line D appears darker than usual in the solar light, and stands out bright in the electric spectrum. Thus the arc, remarks Foucault, presents us with a medium which emits the rays D on its own account, and which at the same time absorbs them when they come from another quarter.

The explanation given by Stokes of this experiment assumes that the vapour of sodium must possess, by its molecular structure, a tendency to vibrate in periods corresponding to the degrees of refrangibility of the double line D.

Hence the presence of sodium in a source of light must tend to originate light of that quality. On the other hand, vapour of sodium in an atmosphere around a source must have a great tendency to absorb light from the source of the precise quality in question.

In the atmosphere around the sun, therefore, there must be present vapour of sodium, which, according to the mechanical explanation thus suggested, being particularly opaque for light of that quality, prevents such of it as is emitted from the sun from penetrating to any considerable distance through the surrounding atmosphere.

It appears, from the historical sketch here given, that two independent lines of research were progressing towards the same conclusion. The one of these had for its basis the theory of exchanges, and endeavoured theoretically and experimentally to render this theory complete. The other was founded upon spectroscopic investigation, and endeavoured to apply to light an analogy deduced from sound, believing that, just as a string or tuning-fork when *at rest takes up* that *note* it gives out when *struck*, so a molecule when *cold absorbs* that *ray* which it gives out when *hot*.

In October, 1859, Prof. Kirchhoff of Heidelberg made a communication to the Berlin Academy on the subject of Fraunhofer's lines. His observations were made on this occasion by an examination of the spectrum of coloured flames made by Bunsen and himself, and he derived from them the following conclusions:—He concluded that coloured flames in the spectrum of which bright sharp lines present themselves so weaken rays of the colour of these lines, when such rays pass through the flames, that, in place of the bright lines, dark ones appear as soon as there is brought behind the flame a source of light of sufficient intensity in the spectrum of which these lines are otherwise wanting. He concluded further that the dark lines of the solar spectrum which are not evoked by the atmosphere of the earth exist in consequence of the presence in the incandescent atmosphere of the sun of those substances which in the spectrum of a flame produce bright lines in the same place.

Carrying out this train of thought, Kirchhoff, about the end of 1859, shows that as a mathematical consequence of the theory of exchanges, a definite relation must subsist between the radiating and absorbing power of bodies for individual descriptions of light and heat.

It will be noticed in this historical statement that I made my first experiments on dark heat; afterwards I proceeded to the subject of light. Meanwhile, however, Kirchhoff had independently been led to experiment in this direction, and, although his memoir slightly preceded mine in publication, I shall now give the experiments which I was led to make, more especially as they are very similar to those of Kirchhoff. In February, 1860, I communicated to the Royal Society of London a paper in which I showed that the light radiated by coloured glasses is intense, in proportion to their depth of colour, transparent glass giving out very little light. I also showed that the radiation from red glass has a greenish tint, while that from green glass has a reddish tint. It was likewise shown that polished metal gives out less light than tarnished metal and that when a piece of black and white porcelain is heated in the fire the black parts give out much more light than the white, thereby producing a curious reversal of the pattern.

Finally, in a paper communicated in May of the same year, it was shown that tourmaline, which absorbs in excess the rays of light polarised in a plane parallel to the axis of the crystal, also radiates, when heated, this kind of light in excess, but that when it is viewed against an illuminated background of the same temperature as itself, this peculiarity disappears. All these facts are a natural consequence of a movable equilibrium of temperature holding separately for every variety of heat, the word "variety" embracing any difference either in wave-length or polarisation which is the cause of unequal absorption.

The theory of exchanges, as here exhibited, has been founded upon the fact that in an enclosure of constant temperature all bodies will ultimately attain the temperature of the walls of the enclosure. This is the experimental foundation upon which our structure has been built, and we have not attempted to work under it or to find whether in its turn it be not founded upon some principle of a still deeper and more fundamental nature. We shall now briefly indicate that such is the case, and that this law of ultimate equality of temperature is a consequence of the theory of energy in which we are told that no work can possibly be got out of heat which is all at the same temperature. For if the ultimate result in our enclosure should be a variety of temperatures, then it would be possible to utilise this temperature-difference and convert heat into work, so that there would practically result a case of perpetual motion. Now, it is one of the most fundamental axioms of physical science that such a motion is impossible.

I have endeavoured to make use of this method of viewing the problem, in order to point out what forms the natural limit to our conception of a movable heat-equilibrium. Suppose, for instance, that we have a large spherical chamber of the temperature of 100° C., and that this chamber is removed from all gravitating influence, so that a solid spherical body, also of the temperature of 100° C., may rotate on its axis in the centre of this chamber without requiring the support of an axle. The chamber may likewise be supposed to be void of air, so that there is nothing but the ether to bring the revolving body to rest. Now, if a sort of diaphragm or rim be introduced into the chamber, as in Fig. 9, the result will

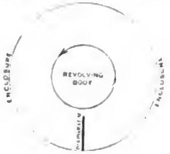


FIG. 9.

be that the particles of the enclosure to the left of the diaphragm will only receive heat from that portion of the revolving body which is approaching them, while those to the right of the diaphragm will only receive heat from those portions of the same body which are receding from them.

But the wave-length of light is altered in one way by a body which is approaching us, and in another way by a body which is receding from us, so that the particles to the left of the diaphragm will, in reality, receive a different kind of radiation from those to the right. Here, then, we have something which upsets the temperature equilibrium, and we may even conceive that the particles to the left of the diaphragm will absorb more heat, and therefore become hotter than those to the right. If so, we shall have the possibility of creating work out of this difference of temperature, or, in other words, of starting a kind of perpetual motion.

We thus begin to see that, somehow, the revolving body must lose as much energy as we gain by means of these differences of temperature, for otherwise we should have the transmutation of heat originally of the same temperature into work, which we cannot admit. But this means that a revolving body placed under these circumstances must gradually part with its energy of visible motion, although it is not in contact with anything else than the ethereal medium.

Before concluding this branch of my subject let me say a few words about phosphorescence and fluorescence.

It is well known that certain substances remain luminous—that is to say, continue to emit light for some time after they have been exposed to the light of the sun or of some other powerfully luminous body. Such substances are said to be *phosphorescent*.

It is likewise known that other substances, more especially certain liquids, emit light in a peculiar way while the luminous source acts upon them, but do not enjoy this property for an appreciable time after it has been withdrawn. Such bodies are said to be *fluorescent*.

It is manifest that the difference between phosphorescence and fluorescence is one of time, the bodies implied by the first term continuing to give out light for some time after the exciting source is withdrawn, while those implied by the second do not retain this property for an appreciable time after the withdrawal of the luminous source. Prof. Stokes, who has done much to advance this subject, has shown that the exc[illegible] of phosphorescence and fluorescence is [illegible] the rays of high refrangibility—even ray[illegible] of the visible spectrum. On the other hand, the rays which the body gives out are generally of a lower refrangibility than the exciting rays. Hence invisible rays may, by means of a phosphorescent or fluorescent body on which they fall, render themselves visible. This phrase, however, is perhaps not strictly correct, inasmuch as, before becoming visible, they have been changed into other rays of lower refrangibility.

The object of introducing this subject here is rather, however, to discuss its bearing upon the theory of exchanges than to treat it as a separate branch of inquiry; and I may commence by remarking that at first sight it seems to contradict the general law that the quantity and quality of the light and heat given out by a body depend upon its temperature, and upon this only. Thus, a thermometer at 100° C. is supposed to radiate from the surface of its bulb heat which will be the same in quantity and quality whether the instrument has been heated by the sun's rays or by plunging it into boiling water. Now in such a body as luminous paint we have the light which we usually associate with a high temperature given out long after the sun has ceased to shine upon it, and when we know its real temperature to be that of the bodies around it. Do phosphorescent bodies form, therefore, an exception to the general law which represents the quality of the radiant heat as a function of the temperature?

I think we shall find, on examination, that in this general law it is taken for granted that no chemical change is taking place in the body in question, and no other molecular change than that implied in the cooling of the body. In a chemical action we have generally the transmutation of chemical energy into heat, and in molecular action we have generally the transmutation of molecular energy into heat likewise. That is to say, the body undergoing these changes becomes heated, and so gives out light and heat peculiar to the temperature to which it has been raised. But there seems to be no reason why molecular energy should not be somehow changed at once into radiant light and heat. In this case there would no doubt be an apparent breaking of the law above mentioned, which associates a certain temperature with a certain quantity and quality of radiant heat, but the exception would be only apparent, for, as we have stated, the law presupposes that no molecular change of this nature is taking place.

In like manner our argument regarding an enclosure of a constant temperature and the theory of exchanges in general, while it allows of the greatest possible variety of substance and form in the enclosure, virtually assumes that no chemical or molecular change is going on amongst the substances introduced. We are, in fine, supposed to be dealing with radiant energy and absorbed heat, and with no other form of energy, and indeed we have just seen that if we have a body in visible motion in the enclosure, the equilibrium no longer holds.

Thus we get rid of the difficulty by rejecting the bodies in question as not fulfilling strictly our requirements. No doubt the phenomena of phosphorescence and fluorescence are comparatively trivial exceptions, but we may imagine an enclosure in which all the substances are at the temperature of 100°, while some one substance is gradually changing its molecular state, until at length we have a violent explosion accompanied with light and heat. Here the result is so obvious that we have no hesitation in recognising such a body as an exception not [illegible]ted by the theory of exchanges. We are per[illegible] phosphorescent [illegible] are equally an excep[illegible] difference be[illegible] character of this [illegible] nearly so [illegible] that the [illegible] are only [illegible] ibl[illegible] of a[illegible] an e[illegible] that matter during one second is equal to its radiation during the same time, and this holds for all kinds of heat. On the other hand, if we take a single molecule and a billionth of a second, we cannot affirm the same equality. This is no doubt correct; in fact, if the equality between radiation and absorption were to hold for the smallest conceivable mass and the smallest conceivable increment of time, our equilibrium would in reality be a tensional one instead of being movable or dynamical. I shall conclude by repeating the words of Tait ("Heat," p. 253):—"It is vain, at least in the present state of science, to look for a truly *rigorous* investigation of the relation between radiating, absorbing, and reflecting powers. In all the professedly rigorous investigations which have been given the careful reader will detect one or more steps which are to be justified only by the statistical process of averages."

BALFOUR STEWART

(*To be continued.*)

## *THE LIFE OF AQUATIC ANIMALS AT HIGH PRESSURE*[1]

THE magnificent expeditions of the *Talisman* and the *Travailleur* have called the attention of naturalists and physicists to the conditions of life at the bottom of the sea. A learned physiologist, Dr. Regnard, has conceived the happy idea of studying experimentally these condition of life at high pressure. With apparatus designed by M. Cailletet, he has subjected aquatic animals to enormous pressure, such as prevails in the depths of the ocean, and has examined the results when those inhabiting the surface are suddenly placed at great depths. Since his first experiments Dr. Regnard has invented an ingenious method by which he can see, notwithstanding the great pressure, what goes on inside the apparatus.

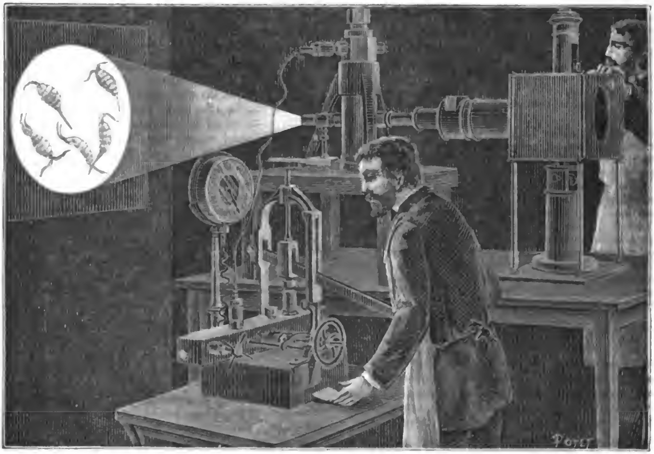

FIG. 1.—General View of Dr. Regnard's Apparatus.

Hitherto the operator simply placed the animals on which he experimented in the iron block of the Cailletet pump, and subjected them to the pressure corresponding to a given depth; he then released them, sometimes very slowly (after several days), sometimes rapidly and even instantly. He examined then, physiologically and microscopically, the lesions produced. But all the intermediate stages between the entrance of the animals and the time they were taken out escaped the observer. But now the apparatus in Fig. 1 allows him to follow each minute the effects. The following is Dr. Regnard's description of his apparatus to the Academy of Sciences:—

Two holes are pierced through and through across the lower part of the Cailletet block, M (Fig. 2). In these two holes, placed in a straight line, are inserted two tubes $r$ and $r'$. These are hollow, and in each of them is solidly fixed a cone of quartz, B, the extremity of which joins the edges of the hole which is pierced in the screw nut E. A ray of light thrown by the orifice $r$ will thus traverse the apparatus and emerge at $r'$. Experiments have shown that a similar apparatus will resist easily a pressure of 650 atmospheres, which represents that of the greatest depths that have been dredged—about 6500 metres. Across one of the quartz cones are sent the concentrated rays of an electric lamp. These rays cross the block full of water, and emerge on the opposite side, where they are received by an achromatic object-glass which projects them on to a screen. The observer therefore works at a distance from the apparatus, where he is sheltered from all danger (Fig. 1). This arrangement has another advantage. The orifice pierced at $r$ is hardly half a centimetre in diameter, and one can experiment with animalculæ so small as to be scarcely perceptible

[1] From *La Nature*

with the naked eye in the vessel immersed in the block M. By projecting them with a lens they are increased about 200 times, and it is even possible to see by transparence the state of their organs." In the experiment represented in Fig. 1, one of the operators is occupied in regulating the electric lamp and in setting the microscope of projection, while the other commences to apply the pressure. The animalculæ projected on the screen are the *Cyclops*, small crustaceans which are met with at this time of the year in brooks, and which are scarcely a millimetre in length. These are so enlarged, and appear with such transparency, that we can follow on the screen the movements of their branchia, and even of their heart, during the experiment. Dr. Regnard is pursuing at present his

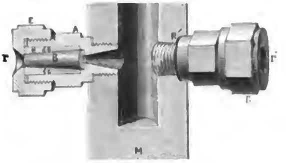

FIG. 2.—Details of apparatus in Fig. 1.

studies into life under high pressures. He showed last year that the unequal compressibility of the liquids and solids which form the organism caused the latter after a long pressure, to be soaked with water, become turgid, and consequently lose their functions. But, with the apparatus here described, he has been able to follow the phenomena which precede this. From the pressure at 1000 metres (about 200 atmospheres) the object shows inquietude, at 2000 metres it falls to the bottom of the vessel struggling; towards 4000 it remains inert and benumbed. When its normal pressure returns it recommences moving, unless the pressure has been long and its tissues are not soaked. This seems to show that the effect is a compression of the nervous system.

## NOTES

WE understand that Mr. Francis Galton has already obtained valuable results from the Family Records sent him last year in response to his offer of prizes, and that he purposes to make much use of them in his Presidential address to the Anthropological Section of the British Association at Aberdeen.

WE have already intimated that Prof. Bonney has decided to retire from the Secretaryship of the Association after the Aberdeen meeting. We understand that Mr. A. T. Atchison will be proposed as his successor.

MANY interesting excursions have been arranged by the Local Committee of the Aberdeen meeting of the Association. One of them will, of course, be to the great granite quarries in the neighbourhood of Aberdeen. Her Majesty has invited 150 of the members to Balmoral, where they will be shown over the grounds and have lunch. It is not to be expected that the Queen will personally receive all the members, though it is possible that a few representative men of science may be presented to Her Majesty. Other excursions will be to Haddo House, Dunecht, Dunnottar, Drum and Crathes, Loch Kinerd, on the Saturday; while on the Wednesday and Thursday of the second week parties will be taken to Braemar, Invercauld, Haddo House, Huntly Castle, Elgin, Banff, Portsoy, and other places. The efforts which the Local Committee are making to render the meeting a success are all that could be desired. It is only to be hoped that they may succeed in persuading the Aberdeen hotel and lodging-house keepers to reduce their exorbitant charges. The arrangements for important discussions in Sections A and B we have already referred to.

IN connection with the meeting we venture to recommend to our readers the new edition of Baddeley's "Guide to Scotland," Part 1, a copy of which has been sent us. It includes all the country from the Borders to as far north as Aberdeen, Inverness, Gairloch, and Stornoway. No more useful, practical, and trustworthy guide to the region exists, while the thirty-seven admirably executed maps and plans will be found a great comfort and convenience. Dulau and Co. are the publishers.

M. JANSSEN will shortly begin a new series of experiments on the influence of gases in spectrum analysis, in continuation of those which he made about fifteen years ago at La Villette gasworks. The tubes in which the gas will be contained and compressed will have a length of more than 100 metres, and be able to bear an unusual amount of pressure. Thus a new degree of accuracy may be expected from these researches, which are progressing favourably at the Meudon Physical Observatory.

FOR more than a year some important measurements of the altitude and movements of clouds have been carried on at Upsala by the aid of two theodolites, one of which is mounted in the Linnæus and the other in the Botanical Gardens. These instruments, which belong to the Academy of Science, were used for auroral and cloud measurements by the Swedish expedition to Spitzbergen, 1882-83. The object of the measurements of the altitude and movements of clouds is not so much to obtain their mean altitude as to derive some knowledge of their movements in the upper part of the atmosphere, a matter which is of great importance to meteorology. The researches have advanced so far that it has been found possible to fix astronomically the movements and altitude of the cirrus clouds.

ACCORDING to the *Tägliche Rundschau* the population of Ratisbon has been greatly frightened by the sudden disappearance recently of thousands of jackdaws, which dwelt in the spire of the cathedral of the town, on account of a similar phenomenon occurring before the outbreak of the last cholera epidemic in the place. In Munich a similar phenomenon is also stated to have taken place.

REFERRING to "sonorous sand," the report of the secretary of the Smithsonian Institution says that an interesting problem to physicists and geologists has been the sand found in certain localities, which, when placed in motion by sliding, sometimes produces a very sonorous or resonant sound, peculiar in character and difficult of explanation. Prof. Bolton, of Trinity College, Hartford, desirous of making researches on the subject, and especially of studying the microscopical, chemical, and physical peculiarities of the grains, requested the aid of the Institution in obtaining materials for the purpose. A considerable variety of specimens was collected in the Sandwich Islands, the coast of Oregon, Germany, and many other places. These are now in Prof. Bolton's hands, and he will prepare a report on the subject.

THE Chesapeake Zoological Laboratory, as the marine station maintained by the Johns Hopkins University is designated, is *Science* states, established for the present summer session at Beaufort, on the coast of North Carolina. Dr. W. K. Brooks, the director, who was prevented last year by ill-health from giving as much time as usual to the laboratory, is fortunately quite restored to his usual strength, and is in full activity at his post. Twelve collaborators are with him. Several of these are already teachers in various branches of zoological science, and all of them are well prepared to make use of the opportunities which are afforded at this station. An unusual number are engaged in original researches. The season of 1885, although uncomfortably hot, has thus far been exceptionally favourable for collection. The weather has been calmer than heretofore in June and July, and specimens were found in June which have usually not appeared until the middle of August. The company, notwithstanding their personal discomfort from the heat, have maintained their full enthusiasm in the work upon which they are engaged; and it now appears as if the eighth session of the laboratory would be more fruitful in results than its predecessors, good as they have been.

A DUNFERMLINE correspondent writes to us that one of the most important and certainly the most complete cemetery of the Stone Age which has been laid bare in recent times has just been discovered in the grounds of Pitreavie, Dunfermline, Fifeshire. In connection with rebuilding operations a sand-pit was opened, and here, in a space of 15 yards by 10 yards, no fewer than five cists have been discovered. The cists were constructed of rough sandstone flags, and four of these measured about 42 inches in length, 20 inches in breadth, and 16 inches in depth. The fifth was little more than 18 inches square. A cinerary urn of baked clay was found in each of the large cists, but in the small "grove" nothing was found but a quantity of apparently calcined bones. A couple of flint scrapers and a bottle-shaped piece of limestone—which may have done duty as a hammer—were also among the finds. The urns measure from 5 to 6 inches across the mouth and from 4½ to 6 inches in height, and, strange to say, the construction of the bowls indicate that they have been made at different successive periods. No. 1 urn is an unshapely piece of sun-dried pottery; No. 2 showed an advance in the shape; and Nos. 3 and 4 are neatly formed and ornamented with a simple dotted pattern. The explorations will be continued, and it is expected that several other important finds will be made. Dr. Munro, the author of "Ancient Scottish Lake Dwellings," has visited the tumuli with a view to place a report in the hands of the Antiquarian Society of Scotland. A tradition exists that the site of the mound was an old graveyard, and some people who have been engaged in the district in agricultural pursuits for the past half a century state that numerous flagstones and pieces of urns have been turned up by the plough or grubbed, and Dr. Munro attaches great importance to the flint scrapers, and was of opinion that the bones found in the small cist were human bones.

AT the recent Railway Congress at Brussels the question whether it would be economical and desirable to use iron or steel instead of wooden sleepers was fully discussed. It was stated that metal sleepers of various patterns are being used in Holland and India to a considerable extent, and that they are being tried experimentally in Belgium, England, and other countries. An opinion was expressed that sleepers of the description which is being tried in England would afford good material support for the rails on main lines, although some inconvenience might be felt from a quoin of wood being used with it. It was also considered that other metal sleepers which are being tried in Holland and elsewhere had given satisfactory results. The cost of metal sleepers is higher than that of wood. They require good ballast, and there had not been sufficient experience from their use, in regard to their duration and maintenance, to enable the section to state specifically the relative advantages of the new description of sleepers. It was therefore considered that further experience is necessary. The difficulty of arriving at a conclusion as to what would be applicable in all countries and under all circumstances was exemplified in the discussion of this subject by the representative of the Egyptian railways. He stated that iron or steel sleepers cannot be economically used in Egypt, because they become corroded by the sand. The representative of the Indian railways, on the other hand, informed the section that iron or steel sleepers only can be used in India, because the white ant destroys wooden sleepers. Considerable discussion took place as to the construction of railways in regard to the curves, gradients, and works generally, including the question whether lines with a comparatively small traffic should be laid with heavy or light rails. It was, however, found impossible to lay down any general propositions which could be adopted under all the circumstances in which railways have to be made.

IT may be remarked that François Arago was born at Estagel in the beginning of February, 1786, so that a centennial celebration may be expected next year. A statue was erected in this place twenty-nine years ago at the expense of the late M. Pereire.

AN exhibition of labour was opened a few weeks ago at the Palais de l'Industrie, Paris. An electrical railway with a single rail was exhibited by M. Lartigue, and is carrying passengers with regularity on a zigzag line of about 200 metres' length. A series of popular exhibitions with magic lanterns on the new features of microscopy is largely attracting public attention. So-called antediluvian music is played on a series of irregular stones which have been selected so that they represent two octaves when suspended by strings.

THE American Ornithologists' Union will hold its next meeting in New York on Tuesday, November 17.

WE have received catalogues of electrical apparatus from two new firms: the first of these is the Kinetic Engineering Company, who are agents in this country for the well-known firm of Breguet. They are now exhibiting Lippmann's ingenious mercurial galvanometer. The second catalogue is that of Messrs. P. Jolin and Co., of Bristol. This enterprising firm describes several instruments of great use in the physical laboratory, especially the dead-beat galvanometer of D'Arsonval's type, and adjuncts therefore. This instrument appears to be specially adapted for private laboratories. We are glad to see new firms taking such good standing in the character of the apparatus they offer to the scientific world.

THE Java newspapers report that volcanic activity in the island continues to increase. Another mountain, called Raun, broke out on June 21, casting out much steam and ashes. In the evening smoke was ejected in such quantities as to darken the horizon on the windward side, until a shower of ashes fell, upon which the sky cleared up. Raun appears to be an active volcano, but no such violent eruption has been known in recent years. On the night of July 8 a new eruption of Mount Smeru took place; it was a heavy explosion followed by a stream of red-hot lava, which came down to the same spot which was laid waste by the former eruption. In the evening of July 9 another explosion followed.

"RESULTS of Twenty Years' Observations on Botany, Entomology, Ornithology, and Meteorology, taken at Marlborough College, 1865-84," is the title of a large pamphlet embracing a summary of twenty years' work. The tables are accumulations of facts properly registered. In the botanical notices the first appearances in each year are given, the day being noted as the day of the *year*, not of the month. This method is readiest for comparison and for striking the average. In addition the average for the twenty years, the earliest and latest days, the amplitude and the number of observations are given. The entomological notices are arranged in the same way, except that the earliest and latest appearances and the amplitude are omitted; these are not a great loss, for they can be ascertained from the tables in a moment by any reader. In ornithology the observations include the date when first seen, and when an egg and the young have been found. The meteorological notices include for each month of each year the highest, lowest, and mean readings of the barometer, the maximum and minimum temperature in the shade, the number of times the thermometer stood above certain points varying with the seasons of the year, the maximum in the sun, the minimum on the grass, amount of rain collected, and the number of rainy days. The wettest year of the twenty was 1882, when the rainfall was 43·79 inches; the dryest, 1870, with 23·41 inches. The weather records in these tables have been kept by one observer, with properly verified instruments, and all the observations have been critically examined at the Royal Meteorological Society; the botanical notices, though obtained by a large staff of observers, have all been recorded by one person, who saw all the specimens; but entomological and ornithological notes were taken by a series of recorders, and there is therefore not the same uniformity as in the two previous cases.

We have received the annual report of the West Kent Natural History, Microscopical, and Photographic Society for the past year. It contains abstracts of several papers read during the year. It is a pity there is no abstract of the discussion introduced by the president at the annual dinner at Gravesend, on "Bacon and Beans." There are two papers on subjects connected with photography.

Mr. W. F. Stanley has recently brought out a new form of protractor and goniometer, which has the special merit of measuring an angle right up to the vertex. This new form of protractor will be very convenient to civil engineers in measuring angles upon ordnance maps which are most frequently subtended by short lines, and many other cases. Used as a goniometer, it will be very convenient to measure the angles of large crystals and planes of cleavage, also to draw the same direct from the instrument. The instrument consists of two concentric circles, the outer one carrying the graduation, the inner a Vernier; each supports an arm with an edge extending to the centre. The angles are measured by slipping the inner circle with its attached arm and Vernier round the groove on the outer circle, which keeps it in position. We believe the instrument has all the good points which Mr. Stanley claims for it, and it will be useful to artists as well in determining angles of perspective.

The whitefish (*Coregonus albus*) now in the ponds at the Delaford Fishery are growing rapidly, some of them reaching seven inches in length. It will be remembered that the ova of these fish were brought from America last spring, and hatched out at South Kensington.

A remnant of the great forests which once covered the south of Sweden was recently dug out of a bog at Kiuneved, consisting of a boat 6 feet in diameter hollowed out of a log. The tree from which it was obtained must have been 20 feet in circumference. The wood, which was blue in colour, was very hard, and the boat so heavy that two bullocks could not move it.

Mr. Henry Phillips, jun., one of the secretaries to the American Philosophical Society, has performed a very useful work in compiling a register of all the papers published in the *Transactions* and *Proceedings* of the Society since its commencement. The "register" forms a small pamphlet of fifty-six pages, the titles being arranged according to the authors' names. It is therefore an index to all the publications of the Society—but a name, not a subject, index.

The additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♂) from India, presented by Mr. E. Pelditch; a Bosmani Potto (*Perodicticus potto* ♂) from West Africa, presented by Mr. C. R. Williams; two Gerbilles (*Gerbillus* ——) from Suakim, presented by Surgeon-Major J. A. Shaw; two White-faced Tree Ducks (*Dendrocygna viduata*) from West Africa, presented by Mr. Cecil Dudley; three Green Turtles (*Chelone viridis*) from the West Indies, presented by M. C. Angel, F.Z.S.; a Bonnet Monkey (*Macacus sinicus* ♀) from India, presented by Mr. J. C. O'Halloran; two Narrow-barred Finches (*Munia nisoria*) from Java, an Indian Silver Bill (*Munia malabarica*) from India, an Amaduvade Finch (*Estrelda amandava*) from India, presented by Mr. Horace Sanders; a Short-toed Eagle (*Circaetus gallicus*) from Southern Europe, presented by Mr. Henry Sotheran; a Mona Monkey (*Cercopithecus mona* ♂) from West Africa, presented by Mr. White; a White-necked Crow (*Corvus scapulatus*) from West Africa, deposited; nine Gold Pheasants (*Thaumalea picta*), received from the Right Hon. George Sclater-Booth, M.P.; a Barred-shouldered Dove (*Geopelia humeralis*), a Coquerel's Lemur (*Chirogaleus coquereli*), a Collared Fruit Bat (*Cynonycteris collaris*), bred in the Gardens.

## OUR ASTRONOMICAL COLUMN

The Binary-star 70 Ophiuchi.—Notwithstanding the care with which the orbit of this double-star has been discussed, the companion appears to be again deviating from its predicted position to a considerable extent. It will be remembered that from the anomalous motion of the smaller star Madler was led to the suspicion that the law of gravitation does not apply in this system, while Jacob thought there was indication of disturbance from a third body.

M. Perrotin gives the following epoch resulting from his measures made at Nice in 1883:

1883·49 ... Position 45°·6 ... Distance 2″·28

On comparing with the orbit assigned in No. 1 of "Astronomical Observations made at the University Observatory, Oxford," which accords closely with the measures up to 1878, and with the orbits Flammarion, Tisserand, and Schur, we find the following differences taken in the order, observation—calculation:—

| | Position. | Distance. |
|---|---|---|
| The Oxford orbit ... ... ... | − 9·9 ... | − 0″·60 |
| Flammarion ... ... ... ... | − 12·8 ... | − 0·18 |
| Tisserand ... ... ... ... ... | − 13·5 ... | 0·57 |
| Schur ... ... ... ... ... ... | − 17·4 ... | − 0·73 |

It is very possible that in this case the difficulty of representing the position of the companion-star may be attributed to the paucity of measures near the peri-astron, rather than to an anomalous motion which has not been remarked in most of the other binaries. However this may be, the object no doubt is one deserving of continued attention. The Oxford orbit, which, it will be seen, is the nearest as regards the position angle in 1883, gives for 1885·5—position, 44°·6; distance, 2″·64.

Tuttle's Comet.—On September 10, at midnight, this comet will be in about R.A. 136° 33′, Decl. + 3° 48′, rising at Greenwich two hours before the sun, and with an intensity of light one-third greater than when first observed at Nice on August 5. It may perhaps be observed after perihelion in the southern hemisphere if the more powerful telescopes are utilised. On August 13 the correction to Herr Kahl's ephemeris was − 13s. in right ascension and + 5′·5 in declination. The comet is about 2′ in diameter, without very apparent central condensation.

The Comet of 1652.—At present we have only one calculation of the orbit of this comet—that of Halley, founded upon the observations of Hevelius in the scarce volume of the "Machina Cœlestis." It would be interesting to investigate the orbit anew from the observations made by Richard White at Rome, though he gives no nearer time for his distances of the comet from stars between December 21, 1652, and January 3, 1652, than "hora 2 post occasum solis." The observations will be found in *Zeitschrift fur Astronomie*, vol. iv., where they are entitled "Observationes Cometæ, qui exeunte anno 1652 comparuit, habitæ Romæ per Riccardum Albium, Anglum." Zach supposed the observer to be Richard White, and there can be little doubt that he is the Mr. White repeatedly mentioned by Evelyn in his Diary. Zach has the remark, "Diese Beobachtungen konnen leicht besser als die des Hevelius seyn," and an examination of the latter will show that there is some foundation for this remark. On December 21, according to Halley's elements, the distance of the comet from the earth was only 0·14; on January 3 it had increased to 0·42.

The fact that the place of the ascending node of the comet of 1698, as it is printed in Halley's "Synopsis of Cometary Astronomy," is 180° in error, or, in other words, the place of the descending node has been given for that of the opposite one, furnishes a hint that it is not safe to accept a single calculation of the orbit of any of the earlier-computed comets without examination.

## *ASTRONOMICAL PHENOMENA FOR THE WEEK*, 1885, *AUGUST* 30 *TO SEPTEMBER* 5

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on August* 30

Sun rises, 5h. 11m.; souths, 12h. 0m. 23·0s.; sets, 18h. 49m.; decl. on meridian, 8° 52′ N.: Sidereal Time at Sunset, 17h. 26m.

Moon (at Last Quarter on Sept. 2) rises, 20h. 28m.*; souths, 3h. 15m.; sets, 10h. 12m.; decl. on meridian, 8° 11′ N.

| Planet | Rises h. m. | Souths h. m. | Sets h. m. | Decl. on meridian ° ′ |
|---|---|---|---|---|
| Mercury | 6 1 | 12 17 | 18 33 | 2 28 N. |
| Venus | 8 7 | 13 57 | 19 47 | 2 47 S. |
| Mars | 0 36 | 8 48 | 17 0 | 22 50 N. |
| Jupiter | 5 48 | 12 28 | 19 8 | 7 6 N. |
| Saturn | 23 43* | 7 52 | 16 1 | 22 25 N. |

* Indicates that the rising is that of the preceding day.

*Occultations of Stars by the Moon*

| Sept. | Star | Mag. | Disap. h. m. | Reap. h. m. | Corresponding angles from vertex to right for inverted image ° ° |
|---|---|---|---|---|---|
| 1 | $\theta^2$ Tauri | 4½ | 22 1 | 22 52 | 62 247 |
| 1 | $\theta^1$ Tauri | 4½ | 22 2 | 22 51 | 82 227 |
| 1 | B.A.C. 1391 | 5 | 23 1 | 23 32 | 117 189 |
| 1 | 81 Tauri | 5½ | 23 9 | near approach | 333 — |
| 1 | 85 Tauri | 6 | 23 21 | 0 1† | 20 284 |
| 2 | Aldebaran | 1 | 1 40 | near approach | 154 — |
| 2 | 117 Tauri | 6 | 22 34 | 23 20 | 84 221 |
| 3 | B.A.C. 1728 | 6 | 0 13 | 0 48 | 9 288 |
| 4 | 26 Geminorum | 5½ | 4 57 | near approach | 146 — |
| 5 | 68 Geminorum | 5½ | 0 58 | near approach | 323 — |

† Occurs on the following day.

The Occultations of Stars are such as are visible at Greenwich.

| Sept. | h. | |
|---|---|---|
| 2 | 18 | Mercury in inferior conjunction with the Sun. |
| 4 | 3 | Saturn in conjunction with and 4° 17′ north of the Moon. |
| 5 | 7 | Mars in conjunction with and 5° 33′ north of the Moon. |

## *GEOGRAPHICAL NOTES*

Sad news has been received from the Dutch African Expedition; its leader, Mr. D. D. Veth, died from disease on May 19, in the camp on the banks of the Kala Kanga River, between Benguella and Humpata. This is a real loss for science as well as to his venerable father, Prof. P. J. Veth, who has given his whole industrious life to scientific work.

The Austrian Government, with the consent of the Porte, has undertaken to make a geographical survey of the Albanian coast, with a view to preparing new maps. Two Austrian gunboats have accordingly left for Corfu with officials of the Chart Department on board. Here they will be joined by the Turkish officers, under whose superintendence the survey will be made.

It is stated in the latest *Ergänzungsheft* to *Petermann's Mittheilungen*, that there are in Peking four institutions at which astronomical and meteorological observations have been made for a number of years: (1) the Chinese Observatory, called *Kuan sang tai*, which has existed for about six centuries. In 1674 the Jesuits provided it with new astronomical instruments, without lenses, which are well preserved to this day. It is situated on the eastern wall of the Manchu town. (2) Bethang, or the Northern Church, the *Collegium Gallorum*, near the Imperial palace. Here in the middle of the eighteenth century the Jesuits erected an observatory, and made many astronomical observations, amongst them the transit of Venus of June 3, 1769. Besides these Père Amiot made meteorological observations for six years, from 1757 to 1762. (3) The Russian Legation, near the southern wall of the Manchu town. The astronomer Fuss, who made a great journey between 1830 and 1832 from St. Petersburg to Eastern Siberia, and by Kiachta to Peking, at the orders of the Academy of Sciences of St. Petersburg, spent seven months here, and organised astronomical, geographical, magnetic, and meteorological observations. (4) Beguan, about 300 metres from the north-eastern corner of the wall surrounding the Manchu city. Here the members of the Russian missionary body, and the native Christians under their direction, carried out a series of magnetic and meteorological observations between 1841 and 1860. In 1864 this Observatory was separated from the missionary establishment, and in 1867 the St. Petersburg Academy of Sciences selected Dr. H. Fritsche for its director, a position which he held for sixteen years. For twelve of these he lived in Peking, while the other four were spent for the most part in journeying through the Chinese Empire and Siberia, in order to inspect the meteorological stations and the three magnetic observatories at Ekaterinburg, Barnaul, and Nerchinsk, to establish new stations, and specially to obtain astronomical, geographical, and hypsometric observations in as large a number of places as possible. His investigations into the meteorology of Eastern Asia were published by the Academy in 1877, and he now publishes in the *Ergänzungsheft* above alluded to the results of his sixteen years' observations in other departments. He describes his numerous journeys in China, Mongolia, and Manchuria, and gives a mass of data with regard to the latitude and longitude of places, and their heights above the sea-level. There are also, in the second part of the paper, a large number of measurements connected with earth magnetism. The title of the paper, which is a long one, and represents a vast amount of travel and labour, is "Ein Beitrag zur Geographie und Lehre vom Erdmagnetismus Asiens und Europas," von Dr. H. Fritsche, *Petermann's Mittheilungen Ergänzungsheft*, No. 78.

In the current number of *Petermann's Mittheilungen* the principal article is an account, historical and geographical, of "a lava desert in the interior of Iceland," and the largest lava area in Europe. The "desert" in question is situated in that part of the plateau in the interior which lies between the Vatnajökull and the rivers Skjálfandafljót and Jokulsá. It is known to the inhabitants of the neighbouring coasts as Odádahraun. The author, Th. Thoroddsen, describes his journey from Myvátn in detail.—Prof. Nell explains Fischer's perspective projection for maps, and gives a map of Asia on this system; while Herr Flegel describes his journey in 1879 with the Henry Venn expedition up the Pico Grande from the Cameroons.

The *Zeitschrift* of the Gesellschaft fur Erdkunde at Berlin (Band 20, Heft 3) is almost wholly occupied with an account by Herr Schmidt of the travels of the friar Rubruk between 1253 and 1255 into the heart of Central Asia, and to the borders of China. This remarkable journey is described and explained with much painstaking learning. The only other contribution to the number is a table of lengths of the principal Russian rivers from General Tillo's survey.

From the latest reports the Australian New Guinea expedition appears to have progressed satisfactorily so far. The Government of Queensland had offered to hold frequent communication with the party by means of the steamer *Alliance*, with a view of obtaining information of the progress of the work of exploration. A branch of the Geographical Society of Australasia is to be formed at Brisbane.

A Parliamentary blue-book (Corea, No. 3, 1885) lately published contains the report of a journey made by Mr. Carles, the Vice-Consul at Seoul, from that place to Phyöng Kang, where some gold mines exist. These lie to the west of the main road between Seoul and Gensan, and were stated to be of greater extent than any existing in Corea. They are in the Phyöng Kang district, in the neighbourhood of the town of Pai-namou-tjang, about 100 miles from the capital. Part of the road lay across a vast lava-field, which appears to exceed in extent even the largest in Iceland. Between Chhöl-wön and Pai-namou-tjang, a distance of 40 miles, there is only one break in its bed, which Mr. Carles attributes to the action of the stream which flows near Phyong Kang, the [illegible] depth of the lava is about [illegible] to 140 feet, and it has a continuous and gradual ascent towards the south. [illegible]

[illegible]

feet in height.

[illegible]

## MINERAL PRODUCTS OF THE UNITED STATES

THE second Report on "The Mineral Resources of the United States," by Albert Williams, [illegible] Department of Mining Statistics [illegible] United States Geological Survey, [illegible] in press [illegible] The Report [illegible] the calendar years 1883 [illegible] 1884, and [illegible] The following are the [illegible] of the production of the more important mineral substances in 1884:—

*Coal.*—The only statistics in which the trade is interested are those relating to the amount of coal which is moved for and reaches the market. [illegible]

ranges from 5 to 6½ per cent. of the total shipments. Of what may be called the commercial product the quantities were as follows:—Pennsylvania anthracite, [illegible]; bituminous and brown coal, lignite, and small [illegible] anthracite mined elsewhere than in Pennsylvania, [illegible] long tons; total, 97,594,005 long tons. The spot value of the commercial product was: Pennsylvania anthracite, [illegible]; bituminous and all other coals, $70,219,561; total, [illegible]. Including the local consumption, &c., the total product may be stated at 106,906,295 long tons—namely, [illegible] long tons of Pennsylvania anthracite and 73,730,539 long tons of bituminous and all other coals; and the value at the mines was: Pennsylvania anthracite, $66,351,512; bituminous and other coals, $77,417,066; total, $143,768,578. [illegible]

*Coke.*—There were 4,873,805 short tons of coke made in 1884, worth $7,242,878 at the ovens. [illegible] This production was [illegible] less than in 1883, and the value [illegible]

*Petroleum.*—The production of crude petroleum in 1884 [illegible] of 42 gallons each, of which the Pennsylvania and New York oil-fields produced 23,622,758 barrels. [illegible] average spot price of 85 cents, was [illegible]

[illegible]

[illegible] was 145,221,934 pounds, worth [illegible] 12½ cents per pound in New York [illegible] pounds greater than [illegible] the value was $275,120 less than [illegible] In 1884 4,224,000 [illegible] ("blue vitriol") were [illegible] $181,632. [illegible] Total value, at an [illegible] on the Atlantic sea-board, [illegible] tons less than that of [illegible] was $1,785,677. The production [illegible] is estimated at about 65,000 [illegible] $6,317,500, almost all [illegible] The production of litharge [illegible] contained.

*Zinc.*—[illegible] of metallic zinc, 38,544 short tons; worth, [illegible] 4.44 cents per pound in New York City, [illegible] The output was 1672 tons greater than in 1883.

[illegible]

... of the surface in midsummer is confirmed by other [illegible] ... upon this point I have grouped [illegible] ... those ascents which afford a sufficient number of [illegible] ... deduce therefrom the height of the isothermal [illegible] ... This table includes twenty-three ascents by [illegible] ... at different seasons of the year; [illegible] ... were made during the summer months. The [illegible] ... conclusions drawn from this table:—

In the warmest summer months the isothermal surface [illegible] was found to be at an height of about 3000 to [illegible] ... sink even at this season to about 2000 [illegible] ... feet above the level of the sea. It generally [illegible] ... of the forenoon, and, apparently, more rapidly [illegible] ... It sinks in the course of the afternoon [illegible] ... rapidly with the greater distance [illegible] ... may vary about 2000 metres in from one to [illegible] ... from rising to sinking does not occur [illegible] ... perhaps one hour or even more after noon [illegible]

[illegible] of the decrease of temperature [illegible] ... especially just before the storm, [illegible] ... Only few data exist on this point.

[illegible] ... at 6 p.m. on the 31st August [illegible] ... had taken place at 8 a.m. [illegible] ... isothermal surface of zero, but found a [illegible] ... height of 2300 metres (say 7500 feet). [illegible] ... temperature at a similar height [illegible] ... the beginning of September.

[illegible] ... made an ascent during the night of the [illegible] ... 15 July, 1868, and met with 0° C. at [illegible] ... feet, but this was at [illegible] ... ascents there is only one [illegible] ... was met with at a lower level [illegible] ... in the afternoon of the [illegible] ... before the occurrence of a thunder[illegible] ... surface of zero lay at a height [illegible] ... 11,000 feet, but it was rapidly sinking. [illegible] ... of temperature upwards [illegible] ... in this case.

[illegible] ... conclusion based upon the [illegible] ... observed with sultry thunder[illegible] ... of temperature with height is [illegible] ... the formation of thunderstorms, [illegible] ... to obtain more precise data upon [illegible] ... meteorological investigation [illegible] ... temperature existing just before [illegible] ... in the Brocken and the [illegible] ... I found that in [illegible] ... comparison, in the years [illegible] ... temperature just before the thunder[illegible] ... of the day and season in three [illegible] ... was greater.

[illegible] ... in most cases, the abnormal [illegible] ... with height, and, in connection [illegible] ... of the isothermal surface [illegible] ... of the condition of weather.

[illegible] ... must be paid to the nature of [illegible] ... but also more especially [illegible] ... clouds which lie above the isothermal [illegible] ... consist of [illegible] ... formation of clouds of superior [illegible] ... the appearance of the [illegible] ... from that of the water [illegible] ... and the latter [illegible] ... to the height of clouds, made [illegible] ... agree in showing [illegible] ... in midsummer lies [illegible] ... which agrees pretty well [illegible] ... of the isothermal surface [illegible] ... that balloonists frequently [illegible] ... for instance, Glaisher [illegible] ... and 3300 metres (say 11,000 [illegible] ... 1874, at 3450 metres [illegible] ... July 27, 1850, between [illegible] ... 20,300 feet); Welsh on [illegible] ... to 20,000 feet).

[illegible] ... and water clouds, [illegible] ... from the earth, is always [illegible] ... we have in many cases an [illegible]

National Scholarships, and Free Studentships, Mar. 1885:— William Barton, aged 18, science teacher, Manchester, National Scholarship; Philip L. Gray, 19, assistant master, Southampton, National Scholarship; [illegible] [illegible]

We have received the calendars for the ensuing session of the University College, Dundee, and of the [illegible] College of Science, Newcastle-on-Tyne. [illegible]

## SOCIETIES AND ACADEMIES

PARIS

**Academy of Sciences**, August 17.—M. Bouley, President, in the chair. [illegible] ... and a vast quantity of earthenware, funeral urns, vases, &c., covered with ornamental designs remarkable for [illegible] delicacy and taste, either painted, incised, or modelled [illegible]. Some of the signs appear to be of a hieroglyphic character, [illegible] certain analogies to the early Chinese, Egyptian [illegible] Mexican writings. One inscription, which M. [illegible] attempted to interpret, seems to speak of long migrations, [illegible] probably from the Andes highlands down the Amazon [illegible] towards the Atlantic seaboard.—Experimental research[illegible] cholera, by MM. Paul Gibier and van Ermengem. [illegible] by their respective Governments to study Dr. Ferran's [illegible] of preventive vaccination, these biologists have [illegible] arrived at the same conclusion, that the sub-cutaneous [illegible] of the cultivated [illegible] (comma bacillus) does not [illegible] [illegible] the animals on which their experiments have been [illegible].—Observations of Tuttle's comet made at the Observatory [illegible], by M. Perrotin.—[illegible] observations of Barnard's comet (a) made at the Observatory [illegible] Algiers with the [illegible] telescope, by M. Ch. [illegible].—Account of a remarkable white protuberance observed [illegible] [illegible] of the disk at Paris on August 16, by M. [illegible].—Description of a new magnifying apparatus [illegible] of microscopic objects as well as of [illegible] dimensions, by MM. Theodore and Albert Dubosq.—[illegible] action of the iodide of phosphonium on the oxide of [illegible], by M. J. [illegible].—On the elective alcoholic fermentation [illegible] agar, by M. H. Leplay. Against the objections of [illegible] and Maumené the author maintains from [illegible] experiments that the elective alcoholic fermentation [illegible] [illegible] and described by M. Dubrunfaut really [illegible] must be accepted as a scientific although hitherto [illegible] phenomenon.—On the organisation, anatomy, and [illegible] [illegible] of Pachydermia [illegible], by M. Remy [illegible].—[illegible] and composition of the gases contained [illegible] of floating and submerged aquatic plants, by [illegible] [illegible] J. Peyrou.—Recurrence of the [illegible] [illegible] in the neighbourhood of Douai [illegible] [illegible] Nord, by M. [illegible]

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## The English Illustrated Magazine

[illegible]


A NEW GIFT BOOK

## The English Illustrated Magazine 1885

[illegible]

NOTICE

[illegible]

AUNT RACHEL

[illegible]

Printed by Richard Clay and Sons,


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THURSDAY, SEPTEMBER 3, 1885
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NEWCASTLE-UPON-TYNE.

THURSDAY, SEPTEMBER 3, 1885

## THE ANDAMAN ISLANDERS

*On the Aboriginal Inhabitants of the Andaman Islands.* By Edward Horace Man, Assistant Superintendent, Andaman and Nicobar Islands, with Report of Researches into the language of the South Andaman Islands, by A. J. Ellis, F.R.S. Reprinted from the *Journal* of the Anthropological Institute of Great Britain and Ireland. (London: Trübner and Co.)

"IN considering the habits, customs, and physical peculiarities of a savage race, it is important to acquire as much information as possible regarding the land they inhabit, and also to ascertain the nature and extent of the influences exercised by, or resulting from, their intercourse with other nationalities."

The author of the work from which the above extract is quoted has proved himself fully qualified to treat of this interesting race of people, among whom he resided for four successive years in his capacity of Assistant Superintendent, from the scientific point of view which he has so well defined in the foregoing passage. The volume before us consists essentially of a series of papers communicated at various times since 1880 to the Anthropological Institute, and now republished, with the sanction of the Institute, in a separate form, with an introduction and fourteen short appendices. The report on the language of the South Andaman Islands concludes the volume, and bears a separate title-page indicating that it has been drawn up by Mr. A. J. Ellis, F.R.S., from the materials furnished by Mr. Man and Lieut. R. C. Temple, of the Bengal Staff Corps.

The Andaman Islands consist of a group situated in the Bay of Bengal between the 10th and 14th parallels of N. latitude, and comprise Great and Little Andaman, the former consisting of North, Middle, and South Andaman, together with the Archipelago, Interview, Rutland, and many other small islets. The entire area of the islands is estimated at about 2508 square miles, of which about 2000 square miles are comprised in Great Andaman. Some pages of the introduction are devoted to a description of the physical features, climate, and scenery, the author calling special attention to the numerous fine harbours which offer safe anchorage during all seasons. With respect to the population, Mr. Man estimates the total number of the aborigines of Great Andaman as probably about 2000, and of those inhabiting Little Andaman 1000 to 1500; the aggregate population of all races is about 15,000, nearly four-fifths of this number being made up of the convicts inhabiting the penal settlement. A succinct history of the settlement is given, from which it appears that the modern history of the Andamans dates from 1857, although a previous attempt to found a penal station had been made by the Honorable East India Company, but this was abandoned in 1796 on account of the high death-rate.

The author recognises eight distinct tribes of aboriginal inhabitants in Great Andaman and one in Little Andaman. The natives with which the officers in charge of the station at first came into contact displayed much hostility and considerably harassed the operations of the working parties; but improvements have gradually been effected in the relationship between the aborigines and the settlers chiefly through the establishment of Government homes, and now, as Mr. Man states in a passage quoted from Dr. Day, "the convicts are left unmolested, the implements of agriculture are not stolen, the fishing stakes are left undisturbed, the gardens are no longer pillaged, runaway convicts have been recaptured, and shipwrecked sailors assisted." The author, who had charge of one of the homes, also states that these "have effected good in bringing together members of the various tribes, between whom the way has thus been paved for intermarriages, which were of course formerly of rare occurrence; tribal feuds have also here been amicably arranged, while, through visits paid to Port Blair and other homes by members of all the Great Andaman tribes, as well as by our visits in the station steamer to the more distant encampments, the knowledge of our power, resources, and kindly intentions has spread throughout their respective territories." The aboriginal inhabitants of Little Andaman are, however, still unreclaimed, and all attempts to civilise them have hitherto failed; their hostility towards strangers is such that any persons unfortuate enough to be cast on their shores would be as ruthlessly slaughtered now as at any period prior to our annexation of the islands.

The effect of the contact with civilisation upon those more friendly tribes who have accepted the advantages offered by the homes is however similar to that which invariably results from all such attempts:—"in proportion as they gain in intelligence and tractability, the more fat and indolent do they become, and, having no incentive towards exertion, frequently lose in great measure their quondam skill in hunting." Still more serious is the moral deterioration which has taken place through contact with the convict population, and Mr. Man is careful to point out that his observations have been confined to those primitive communities which have not yet had time to be affected by the virtues and vices of modern civilisation. One interesting point which has been brought out by an attempt to educate the native children is that up to the age of ten or eleven they are as intelligent and can learn as well as the children of civilised races, but after this age no further progress is possible. This feature in the mental evolution of savage races has, if we remember correctly, been observed in the case of many other uncivilised tribes.

In the succeeding portions of the volume we have an immense amount of detailed information upon all the points which are likely to be of value to the anthropologist. With regard to the vexed question of the origin of the race, Mr. Man considers that the natives are the direct descendants of the prehistoric inhabitants, that they all belong to the same race, and that the tribal differences are the effects of isolation by the natural barriers of the country and the constitutional jealousies and hostilities which formerly prevented the tribes from living on amicable terms with each other. Ethnologically the author regards these people as Negritos, and "racial affinity—if there be any—may possibly some day be found to exist between them and the Semangs of the Malayan Peninsula, or the Aëtas of the Philippine Islands."

Following the section on the ethnology of the Andamanese we have an excellent description of their form and size, forty-eight males and forty-one females having been most carefully weighed and measured, with the result that the average height of the men is 4 feet 10¾ inches and of the women 4 feet 7¼ inches, and the respective average weights 98¾ lbs. and 93½ lbs. To give an idea of the thoroughness with which the author has dealt with his subject, under the heading "Anatomy and Physiology," we have a series of five sets of observations on the temperature and rate per minute of respiration and of the pulse on five subjects ranging in age from seventeen to twenty-two years. Descriptions of the pathology, medicine, physiognomy, physical powers and senses, psychology and morals, magic and witchcraft, of the tribal distribution, topography, arithmetical faculties, and of their habitations, government, laws, crimes, &c., complete the first part.

With respect to diseases it appears that pulmonary consumption and other pectoral complaints are or were the chief causes of mortality among these people; to these have unfortunately now to be added that "terrible scourge" which has spread over the greater part of Great Andaman, and which, as in Australia, unless successfully dealt with, threatens, as Mr. Man informs us, "the early extermination of the race."

The morals of the Andamanese in their primitive state appear to be of a distinctly high standard, as will appear from the following extracts:—

"Much mutual affection is displayed in their social relations, and, in their dealings with strangers, the same characteristic is observable when once a good understanding has been established . . . every care and consideration are paid by all classes to the very young, the weak, the aged, and the helpless, and these, being made special objects of interest and attention, invariably fare better in regard to the comforts and necessaries of daily life than any of the otherwise more fortunate members of the community. Andamanese children are reproved for being impudent and forward . . . they are early taught to be generous and self-denying . . . the duties of showing respect and hospitality to friends and visitors being impressed upon them from their early years," &c. With regard to their modesty Mr. Man states that the esteem in which this virtue is held, "and the self-respect which characterises their intercourse with each other may even be said to compare favourably with that existing in certain ranks among civilised races." It is much to be regretted that the so-called "civilisation" with which these people have been brought into contact should have led to the moral deterioration which the author with scientific candour does not scruple to disclose. It is perhaps hardly necessary to add that the stories concerning the prevalence of cannibalism among these tribes have been completely disproved both with respect to the present time and to former periods of [illegible].

In the second part of his intere[illegible] the author treats of the language, rela[illegible] itiatory ceremonies, marriage, deat[illegible] stitions, religious beliefs, demonology [illegible] the third part we have an account of th[illegible] of the Andamanese, their mode of life, ga[illegible] [illegible]nts, and a description of their weapons, [illegible] &c. Want of space forbids anything more than a mere mention of the ground covered by these sections, but it will suffice to say that they are characterised by the thoroughness which is such a valuable feature of Mr. Man's work. The few slight defects which we have noticed are on matters of quite minor importance, such, for instance, as the statement in the introduction, that "the water in the harbour of Port Blair has been found to be remarkable for its high density, as is evidenced by the rapid oxidation of iron immersed in it:" in its present form this reads rather like a case of *non sequitur*.

It remains only to add that in the fourteen appendices we have a mass of most valuable information on various subjects connected with these islands and their inhabitants: most of these appendices are philological; one is devoted to a list of the native trees, and another to a list of the shells.

The Report on the language of the South Andaman Islanders is reprinted from the *Transactions* of the Philological Society, before which body it was delivered by its author, Mr. A. J. Ellis, F.R.S., as his retiring presidential address in 1882. The volume is illustrated by a good series of typical photographs of the natives and five plates of weapons, ornaments, &c., and a map of the islands forming a frontispiece.

In concluding this notice we must not omit to mention that Mr. Man's mode of treatment is based upon the instructions drawn up by Col. Lane-Fox (now General Pitt-Rivers) on behalf of a Committee of the British Association, and published among the Reports for 187[illegible]. This Report was afterwards issued in an expanded form as a Manual of Anthropological Notes and Queries, and the work now under consideration may be regarded as one of the most important practical results of the labours of the Committee referred to. We believe that Mr. Man is at present engaged in a similar study of the inhabitants of the neighbouring Nicobar Islands, one of which—Camorta—was selected as a station by the Eclipse Expedition of 1875. We shall look forward with much interest to the continuation of the author's labours in this new field.

R. M.

## COMMERCIAL ORGANIC ANALYSIS

*Commercial Organic Analysis.* Vol. I. By Alfred H. Allen, F.I.C., F.C.S. (London: J. and A. Churchill, 1885.)

NOT[illegible]TANDING the fact that enormous [illegible] ext-books on chemical [illegible] have been [illegible] recent years, a f[illegible] [illegible]tensive works [illegible] of commercial [illegible] long [illegible] When it i[illegible] every day [illegible] availin[illegible] more of the [illegible] chemical an[illegible] But the truth is [illegible] tional qualificatio[illegible] ence are necessa[illegible] must be thorough[illegible] [illegible] quently leads them to devise or modify processes without any record appearing outside their own laboratories. Almost every analyst has his own manuscript "process-book," according to which he expects his assistants or pupils to work, and so it becomes a matter of extreme difficulty for an author to produce a work that shall be generally acceptable as a laboratory guide. The too frequently occurring discrepancies in commercial analyses may in a measure be attributed to the same cause, and there can be no doubt that a unification in the methods of conducting and recording analyses is greatly to be desired. This end will doubtless be greatly furthered by the production of standard books such as the present one.

A first edition of the work before us appeared in 1879. It has undoubtedly taken already a very high position, and has been welcomed as filling a conspicuous gap in the literature of analytical chemistry. The value of a division between organic and inorganic analysis to the ordinary analyst may not be great, but it is useful to the author in enabling him to keep his work within bounds. The first edition of the book appeared in two volumes; in the new edition a rearrangement and extension is being made, and it will now occupy three volumes. The first volume deals with organic bodies of the fatty series and of vegetable origin, and includes chapters on the alcohols, ethers, and other neutral derivatives of the alcohols, sugars, starch and its isomers, and vegetable acids. The second volume, which is to appear shortly, will be devoted chiefly to coal-tar products and bodies of the aromatic series, to hydrocarbons generally, fixed oils and the products of their saponification, and the tannins. Nitrogenised organic substances, including cyanogen compounds, alkaloids, organic bases, and albumenoids will be treated of in the third and concluding volume. This arrangement of the subject is, we think, a great improvement on the previous one, and makes the book much more convenient for reference.

Mr. Allen treats his subject in as scientific a manner as possible, and this gives quite a peculiar character to his work. It is not, like so many books on analysis, merely a series of receipts or processes of chemical handicraft; but a work assuming the possession of some really scientific knowledge on the part of those using it. It would be easy to go too far in attempting to generalise in such a subject as commercial analysis and in introducing theoretical details; but although the author goes so far, for instance, as to introduce structural formulæ for many of the substances dealt with, it cannot be said that he demands more knowledge than should be forthcoming from those engaging in this difficult and often obscure branch of analysis.

The introduction, extending over thirty-five pages, [illegible]ces a description of some general methods, such as [illegible]ermination of specific gravity, of melting- and [illegible]oints, optical properties, &c. The rest of the [illegible]devoted to a consecutive account of substances [illegible]der the several headings. After the author [illegible]riefly but sufficiently what the substance [illegible]e gives the methods for its detection, [illegible]is, and intersperses the account [illegible]tion as is likely to be of value [illegible] attempt to enumerate the [illegible] of products dealt with in the course of the work. Wines, beers, cordials, tinctures, chloroform, sugars, confectionery, starch, vinegar, the commercial acetates, tartrates, and citrates—are examples taken at random, which will serve to give some idea of the variety. They are, however, treated in a connected manner, in illustration of which we may refer with special approval to the division on sugars, and starch and its isomers.

With regard to the methods recorded by Mr. Allen we may say that on the whole they are such as have borne the test of experience, whilst new processes or modifications of old ones are duly referred to and discussed. The author acknowledges assistance from many men of experience, and has, we think, used it to the best purpose. His descriptions are clear and concise, and the book is remarkably free from errors of any kind. We think it really an excellent enterprise, excellently carried out, and congratulate Mr. Allen on having produced a scientific and thoroughly practical book which, we are confident, will find a place in the library of every practical chemist.

## *RECENT TEXT-BOOKS OF DETERMINANTS*

*Lecciones de Coordinatoria con las Determinantes y sus principales aplicaciones.* Por D. Antonio Suarez y D. Luis G. Gascó. (Valencia, 1882.)

*Traité Élémentaire des Déterminants.* Par L. Leboulleux. (Genève, 1884.)

*Die Determinanten, fur den ersten Unterricht in der Algebra bearbeitet.* Von Dr. H. Kaiser. (Wiesbaden 1884.)

*Lessons Introductory to the Modern Higher Algebra.* By George Salmon, D.D. Fourth Edition. (Dublin, 1885.)

THE first of these works is outwardly a very handsome volume, and on examination we find that the authors have also done their part in the most painstaking and methodical way. The main part of the title, "Coordinatoria," is apt at first to mislead, and indeed after a cursory glance at the contents a cosmopolitan reader might be pardoned for thinking that "Coordinatoria" was a misprint for "Combinatoria," for what our grandfathers spoke of as the *Ars Combinatoria* is the subject of the opening chapters. "Coordinatoria" it is, however, and in the preface it is placed as a science side by side but in contrast with the science of Quantity.

There are in all twenty chapters in the book. The first seven (146 pp.) deal with permutations, combinations derangements or inversions of order, substitutions, and difference-products: they form a lengthy and most carefully prepared introduction to the theory which follows. The next ten chapters (242 pp.) deal with determinants, and expound all the more important properties in the most methodical, simple, lucid and ungrudging manner. The learner, for example, is prepared for the evaluation of a determinant whose elements are expressed in figures by—

§ 327. Simplification by addition.
§ 328. Simplification by subtraction.
§ 329. Simplification by addition and subtraction.
§ 330. Simplification by multiplication.

And so on, up to—

§ 335. Simplification by multiplication, addition, and subtraction.

An impatient Briton might be tempted to call this "simplification to the death," but after calmly perusing the whole he might be induced to confess that he had said so in his haste. The last three chapters deal with applications of determinants: one is arithmetical, and is mainly concerned with continuants and magic squares—a rather invidious juxtaposition; one is algebraical, and gives the determinantal solution of a set of simultaneous linear equations; and the last is geometrical. A very valuable feature of the book is a *résumé* in 40 pp. of all the definitions and theorems given in the preceding 410 pp. No one but a most enthusiastic and painstaking teacher would have thought of adding such an admirable abstract.

The next book on our list might have been more accurately described as a *very* elementary treatise: it must have been intended for pupils with exceedingly little algebraical training. The first 18 pp. are occupied with determinants of the second order, and they are followed by 33 pp. treating of those of the third order. It may be safely affirmed that the pupil who requires 18 octavo pages to teach him the theory of such abstruse functions as determinants of the second order would do well to redirect the expenditure of his mental energy. The book is carefully and accurately written, and there is a wealth of simple exercises in it, worked and unworked.

Dr. Kaiser's pamphlet is of the same ultra-elementary character—considerately restricted, however, to 23 pp. On a former occasion (NATURE, vol. xxix. pp. 378, 379) we drew attention to the fact that a new Introduction of this kind appears every year in Germany, and that of late they have not been improving. We merely notify, therefore, that this is the production for 1884.

The preparation of a new edition of Salmon's "Modern Higher Algebra" has been entrusted to Mr. Cathcart. It contains about 40 pp. of new matter, the chief increase arising from the expansion of the chapter on "Applications to Binary Quantics" into *two* chapters, the first with the old title, and the second headed "Applications to Higher Binary Quantics." The changes made on the portion which deals with determinants are slight, and consist chiefly in the insertion here and there of well-chosen examples.

## OUR BOOK SHELF

*The Three First Years of Childhood.* By Bernard Perez. Edited and translated by Alice M. Christie. With an introduction by James Sully, M.A. (London: W. S. Sonnenschein and Co., 1885.)

THE earliest years of infancy are of importance to two classes of inquirers—to the educator who knows how much evil results from the wrong treatment of young children, and to the evolutionist who, rejecting the *tabula rasa* of Locke, looks to infancy as the time freest from any effect of artificial training. In the study of other *men's* minds the observer is as likely as not to be purposely deceived by them, whereas deceit is an accomplishment which few infants have attained to.

Mr. Bernard Perez seems well to combine these characters. He is an educator who has published various works on school matters, and he describes man as an animal which ought to be reasonable, while he is not necessarily so, as criminal scandals and the success of bad novels prove. He notes that the preponderating elements in a child's will are impulsiveness and stubbornness, incapability of fixed attention, qualities most opposed to the temperament of philosophy and discipline. Much of his book is advice to practical educators, whom he urges to study the manifestations of infancy and to endeavour to lead their youngest pupils by example and not check their behaviour by authority; their intellect should be helped, not controlled. He specially points out the danger of deceit before even the youngest of children.

But, on the other hand, there is little of the tone of the pedagogue in his book. Far more is it a book of suggestion than one teaching with authority, and it will encourage the spirits of fruitful doubt and inquiry in the mind of every reader. He enters heartily into the teaching of modern science, even to using the argument that infants have not certain sensations *because* they would be of no use to them at that age; and, thinking it necessary to caution his readers against leaving everything to hereditary dispositions and powers. He urges the importance of comparing early human life with animal life, thus making cats, dogs, birds, and babies more interesting than before. We may enjoy his book without accepting the teaching that human language has grown out of such involuntary signs as laughter, sobs, and screams, afterwards performed voluntarily. No doubt these involuntary sounds are of more use to an infant than more sober utterances, and have therefore become innate and involuntary, while language is an artificial acquirement. We think that few who have watched their vigorous antics will feel sure that a state of equilibrium, a passive state of health, or even that of moderate and appropriate exercise in moving their limbs, is the most enjoyable sensation to infants, though this latter pleasure is sufficient to explain many actions of infants for which our author seeks a deeper reason. On the other hand, we think that the moral sense has become more deeply impressed than he suggests, and is far from entirely the result of approbation and disapprobation.

Attention and vivid perception seem strangely shaken up in his remarks; the latter faculty explains the dislike which children have to hearing a tale repeated with variations. They have indeed got it all "by heart."

Mr. Sully, in his very suggestive introduction, raises the question, Who is best qualified to follow up this delicate business of observing and rightly explaining all the movements and utterances of such young objects? Neither father, mother, nurse, nor doctor is completely qualified for the study. Mr. Sully concludes that the father and mother must conjointly undertake the work, the cooler intellect of the one checking and steadying the close and loving knowledge of the other. Let us suggest that an elder sister is most likely to succeed, and thus indicate a path to intellectual usefulness and even eminence well fitted for a lady's sphere. It will elevate every little labour from drudgery into a scientific study of variations and resemblances of the greatest importance, and add immensely to the interest of nursery life in a large family. On such observations may be based, by herself or by more ambitious philosophers, theories of racial varieties, of biology, and of education. Sir W. Hamilton points out that the study of the human mind requires no scholarship or costly apparatus, and the principal acquirement necessary for success in the study we suggest is a little close knowledge of one's own thoughts and feelings. In recording observations Darwin's golden rule must always be strictly adhered to: Theorise freely—every other observer will help to demolish anything that will not hold water, and whether true or not it may be a suggestive hypothesis. Be most scrup[illegible] as a fact [illegible] prove [illegible] truth [illegible]

*Un Capitolo di Psicofisiologia.* Da Enrico dal Pozzo. Foligno, 1885.)

A GOOD book on abnormal mental phenomena of all sorts was to be expected from Prof. dal Pozzo, one of the very oldest living investigators of this branch of physiology in Europe. The present excellent little treatise comprises the substance of seven lectures delivered during the current year to the medical students at the University of Perugia on "Hypnotism," "Animal Magnetism," "Somnambulism," "Human Radiation," and "Psychism." The whole field is thus covered from the time of Mesmer down to Mr. Crookes's experiments, and the still more recent "Thought Readings" of Mr. Bishop and Mr. Cumberland. As a philosopher of the monist school, the author naturally rejects the spiritualistic conception, accepts the term "psychism" only in Mr. Crookes's sense, and regards all these manifestations as strictly co-related and explicable on physiological grounds. Human radiation he is also disposed to admit as a biological property, hence has no difficulty in believing in such well-attested facts as may be explained by it. But whatever cannot be so explained he regards as unworthy of credence, and treats the terms "spiritual," "transcendental," and the like, as synonymous with ignorance. The power claimed by paid mediums to hold commune with the departed is, of course, emphatically denied, and it is cogently argued that the medium can tell us nothing regarding present or past facts of which the audience may be ignorant. He cannot, for instance, say how many chairs are in the next room if the number is unknown to all present, whereas the somnambulist will often tell it exactly. Hence if these psychic manifestations did not depend on human radiation, but were the work of spirits, it would follow that these spirits are more ignorant than ordinary somnambulists. And to the assertion that psychism produces phenomena absolutely inexplicable by human radiation, the answer is that who cannot do the less can scarcely do the more in matters of this sort.

At the end of the work a chapter is added on Giordano Bruno, and his philosophic system, which, although not directly connected with the subject, will repay perusal.

*Die Nutzbaren Pflanzen und Tiere Amerikas und den alten Welt vergleichen in Bezug auf ihren Kultureinfluss.* Dr. L. Höck. (Leipzig: E. Engelmann, 1884.)

IN a pamphlet of fifty-eight pages Dr. Höck institutes a comparison between the useful plants and animals employed by man in the two hemispheres. Although the comparison is made in a somewhat rambling manner in the text, the conclusions arrived at are clearly tabulated in the form of an appendix. The influence of useful plants and animals on civilisation seems almost lost sight of, except on p. 10, where guesses at their mode of influence, rather than evidence proving it, are offered. Only those species considered by Dr. Höck to be the most important to mankind are noticed; hence the comparison can only be regarded as approximate to the truth. The author finds that the Old World or eastern hemisphere affords 269 useful plants and 58 animals against 52 plants and 13 animals derived from the New World. In consideration, however, of the larger area of the eastern than of the western hemisphere, which he estimates as being in the proportion of 9 to 4, he concludes that the New World only affords rather more than half so many as the Old.

The tables in the appendix indicate a certain amount of carelessness or confusion, which slightly vitiates the conclusions arrived at. Thus, *Citrullus Colocynthis* and *Momordica Elaterium* are classed under fruits used as food, instead of under medicinal plants; *Rumex Patentia* is indicated as English spinach, and *Haematoxylum campechianum*, which is stated in the text to be a New World plant, is given in the appendix as belonging to the Old World. It is difficult to understand the principle upon which the "more important" plants have been selected, many of them being by no means so extensively used as others which are omitted; this is particularly noticeable in the list of medicinal plants and those used in the arts. But, in justice to the author, it must be admitted that the task he has undertaken is a most difficult one, and cannot be fully treated in so small a space as he has given to it. His claims that the greater proportion of the present work was already completed before De Candolle's "Origin of Cultivated Plants" fell into his hands must also be allowed due weight.

## 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. No notice is taken of anonymous communications.*

*[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]*

### Iona

BEFORE the close of the season when there is easy, and indeed luxurious, access to the Island of Iona by steamers from Oban, I would call attention to the high interest which attaches to its geology in connection with the rocks now called "Archæan."

Although the rocks of Iona are lithologically very distinct from the old gneiss of the Hebrides (which is the true "Laurentian" and closely resembles the rocks near Quebec), yet they are equally distinct from the mica slate series of Argyllshire, and I have always regarded them as undoubtedly belonging to the pre-Cambrian horizons. I had never seen, however, until last week, the beautiful sections exhibited in the precipices of the south-west corner of the island. Tourists often visit the little "Bay of the Coracle," where St. Columba is said to have landed, and I had not myself gone farther west. But the very calm sea of last week tempted me to boat round the farther coast to the south-west, and I was much struck by the sections there seen. The rocks are quite free from vegetation, and the exhibition of the strata is very striking. They are intensely hard and highly silicious—beautifully coloured with red, green, and black—and the beds dip at a high angle with remarkable flexures and faults of all kinds.

On the side of the island where the cathedral is, and which tourists visit, the rock is entirely different in its mineral aspect and character—being a dark or black slaty rock, thinly bedded, and with no bright colouring at all. It belongs, however, evidently to the same series, and has generally the same dip and strike as the beds farther west.

I should be very glad if some geologist acquainted with the different horizons of the Archæan series so largely developed in Canada could visit Iona, and determine to which of these horizons its rocks belong. Between them and the mica slates of the mainland of Argyllshire there is interposed the massive granite of the Ross of Mull—which comes up close to the eastern shore of Iona, and on the other side of which, near Bornepan, the mica schists are in the same relative position; while underneath the granite itself, and sometimes interbedded with it, there are some beds of a dark hornblendic gneiss.

The whole neighbourhood is evidently one of great interest in connection with the oldest metamorphic rocks of our island.

S.S. *Columba*, Campbelltown, August 30 ARGYLL

### Radiant Light and Heat

THERE are two points in my article of last week which I should like to have the opportunity of discussing at somewhat greater length.

(1) In this article I made use of the following expression, having especial reference to phosphorescent bodies which continue after excitement to emit luminous rays at a comparatively low temperature:—"*There seems to be no reason why molecular energy should not be somehow changed at once into radiant light and heat.*" Let me now explain what I meant by this statement. The concluding quotation from Prof. Tait leads us to see that the definite connexion between the quantity and quality of the heat and light given out by a body and the temperature of that body, which the theory of exchanges asserts, is only statistically true. I can imagine, therefore, a few neighbourin g

molecules of some phosphorescent substance to be in a state of constraint, and to relieve themselves, thus causing vibrations which are communicated to the ether—the whole change taking place so quickly and on so small a scale that the statistical law above-mentioned does not apply, and is not therefore broken. Nay, further, I can imagine an enclosure, the walls of which are coated internally with an excited phosphorescent body performing for all practical purposes the part of an enclosure of low temperature under the theory of exchanges, and yet it may be continuing for some time to emit visible rays.

(2) I can, however, imagine the following question to be put: Let there be a phosphorescent substance which is capable of being excited by certain rays coming from a black body at the temperature T, these rays being apparently converted into others of lower refrangibility which continue to be given out for some time by the phosphorescent body. Let us further suppose that the phosphorescent body does not suffer chemical decomposition at the temperature T.

Now imagine a temperature enclosure kept at temperature T, the interior walls of which are lined in part with this phosphorescent substance. What will happen in this enclosure?

I think there can be little doubt that if there be such an enclosure capable of existing permanently and without decomposition of the substances which compose it, then the rays which it gives out must be those required by the theory of exchanges. But if the further question be asked in what way does the phosphorescent body conform to the theory of exchanges, we may, I think, plead ignorance. As far as I am aware we have experimentally little or no knowledge of what the phosphorescent substance will do under these conditions, presuming that it can exist undecomposed. All our knowledge is limited to its behaviour at a low temperature when acted on by high temperature rays, and its peculiar behaviour under these conditions cannot, I think, be viewed as a valid objection to the theory of exchanges.

BALFOUR STEWART

## The Eleven-Year Meridional Oscillation of the Auroral Zone

THIS very remarkable law, in favour of which Mr. Tromholt quotes a short series of observations made at Godthaab, which, he says, are supported by a few in other Polar regions, would, it seems to me, if satisfactorily proved, not only advance the science of terrestrial magnetism a stage, but also materially help to elucidate the exceedingly mysterious bond of union between the aurora and weather. As long as we simply knew that the manifestations of the Aurora Polaris increased and diminished *concomitantly* with the spotted area of the solar surface, we were obliged to conclude that there was a similar increase and decrease in the electrical energy of terrestrial currents, and meteorological evidence did not favour the idea that the eleven-year variation in terrestrial currents was on such an extensive scale as the amplitude of the auroral oscillation would imply. But now if the law which Tromholt has indicated really exists, a great deal of the difficulty in correlating the two phenomena disappears, since it is obvious that a comparatively small displacement of the zone would cause the annual average number of auroræ to increase or diminish by their normal amount. Thus from lat. 60° N. to lat. 65° N., a distance of only 350 miles, the annual average number of auroræ [illegible] 80 to 40.

I will not now dwell upon analogous eleven-year [illegible] of isobars, such as Blanford's Asiatic seesaw [illegible] of similar secular displacements of the Atlant[illegible] Allan Brown and others, or upon the extra[illegible] in form between the auroral zone and the [illegible] the northern hemisphere charted by Prof. [illegible] contribution to meteorology; but I wou[illegible] Tromholt's discovery seems likely to bec[illegible] which may, in the hands of an intelligent a[illegible] worker, clear up the entire question, and I [illegible] no efforts will be spared to corroborate it.

I will conclude by adding my mite. In looking over Fritz's monograph on the connection between solar spots and terrestrial magnetism and meteorology, I have found a series of observations at Godthaab and Jakobshavn (69° 22′ N.) farther north, which do not appear to have been utilised by Mr. [illegible] and which, when combined in the form of percentag[illegible] space of ten years, and a[illegible] strong corroboration [illegible] cated by Tromholt.[1]

[1] "Ueber die Beziehungen der Sonnenflecken [illegible] und meteorologischen Erscheinungen der Erde," p. [illegible]

TABLE I.—*No. of Auroræ seen annually at Godthaab and Jakobshavn, compared with Wolf's Sunspot Numbers*

| Years | 1840 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Godthaab | — | 60 | 57 | 54 | 87 | 74 | 53 | — | — | — | — |
| Jakobshavn | 10 | 15 | 15 | 18 | 12 | 24 | 21 | 17 | 14 | 11 | 21 |
| Sunspots | 63.2 | 36.8 | 24.2 | 10.7 | 15.0 | 40.1 | 61.5 | 98.4 | 124.3 | 95.9 | 66.5 |

TABLE II.—*The above numbers of Auroræ converted into percentages of their means and compared after smoothing with smoothed Sunspot Numbers*[1]

| Years | 1840 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Godthaab | — | 84 | 131 | 118 | 122 | 104 | 45 | — | — | — | — |
| Jakobshavn | 62 | 93 | 93 | 111 | 74 | 148 | 130 | 105 | 86 | 73 | 130 |
| Smoothed means of both | 70.5 | 87 | 106.2 | 122 | 109 | 109.2 | 101.2 | 95.7 | 86.2 | 73 | 130 |
| Smoothed sunspots | 54.4 | 40.2 | 23.9 | 15.1 | 20.2 | 39.1 | 65.3 | 95.6 | 110.7 | 95.6 | 76.3 |

The figures in Table II. speak for themselves.

To corroborate this law by further observation will necessitate a prolonged sojourn in some region *north* of the maximum auroral zone, and Greenland appears to be almost the only region where this could be done in the absence of a regular Polar expedition.

E. DOUGLAS ARCHIBALD

Tunbridge Wells

## On Cases of the Production of "Ohm's (or Langberg's) Ellipses" by Biaxial Crystals

IN examining the macled crystals of potassium chlorate, which are so extremely common in the ordinary crystallised salt, I have found that all those which consist of two hemitrope plates only, nearly equal in thickness, give the above-mentioned secondary interference-curves when placed in homogeneous convergent plane-polarised light.

This result is no more than we should expect if the crystals were uniaxial, as Prof. Langberg showed (*Pogg. Annalen Ergänzungsbd.* i., 540) many years before the curves were independently discovered by Prof. G. S. Ohm (see NATURE for November 27, 1884, p. 83). But potassium chlorate is a biaxial crystal, the angle included by the optic axes being 25° 30′ (determined in olive oil), and I do not find that the production of the curves in such crystals has been hitherto noticed.

The plane of the optic axes, however, makes so large an angle, viz. 38° 30′ (as determined in olive oil), with the normal to the surfaces of the plates in which potassium chlorate usually crystallises, that the isochromatic curves in the vicinity of this normal belong to a very high order, and do not sensibly differ from portions of circles of large radius. Thus in a macle, in which the crystallographic position of one of the components differs by 180° from that of the other, the planes of the optic axes make equal angles of 38° 30′ with the normal on opposite sides of it, and so the conditions determined by Langberg for the production of the secondary ellipses are fulfilled. I have, in fact, made artificial twins of this kind by cementing together plates of the salt oriented as above indicated; and I find that they show the ellipses precisely as the natural macles do. Of course, in order to see them, the compound plate must be so placed that the plane which includes the normal and the two acute bisectrices makes an angle of 45° with the plane of polarisation of the light. In a good [illegible] the four optic axes and portions of the [illegible] immediately surrounding them are visible at the [illegible] of the field.

It is possible, but not common, to find crystals of potassium chlorate consisting of three plates nearly equal in thickness, the [illegible] plates being symmetrically disposed, while the intermediate one differs from them in crystallographic position by 180°. In such cases the secondary interference-curves are much more complicated, two sets of ellipses being generally visible, one on each side of the centre of the field (the exact position, of course, depending on the relative [illegible] of the plates, as Langberg has shown). One [illegible] and [illegible] to [illegible]

I [illegible]

symmetry is either parallel or perpendicular to the plane of polarisation of the light (the analyser being crossed), a few broad, black, curved bands crossing the main black band lying in the plane of symmetry, which are probably portions of the isochromatic curves of a very thin plate. But, on the other hand, some non-iridescent crystals show these bands, and some iridescent crystals do not show them at all. Also the iridescent crystals which reflect D light at moderate incidences show very perfectly the circular band described by Prof. Stokes (NATURE for April 16, 1885, p. 566, par. 9) as sharp black crescents, the horns of which nearly touch each other at the plane of symmetry.

Almost the whole of the ordinary commercial crystallised potassium chlorate seems to consist of macles; so that, in order to get a single individual crystal for examination, I have always had to cut away one component of a twin.

It seemed worth while to try whether other biaxial crystals would, when similarly combined, give similar phenomena. I took a crystal of barite (barium sulphate), the angle included by the optic axes of which is, according to Groth, 63° in air, and cut a plate of it in such a direction that the plane containing the optic axes made an angle of 53° with the normal to the surfaces of the plate. I then cut it in half and cemented one of the portions upon the other in a reversed position. The compound plate thus produced shows the secondary ellipses (which, however, are very nearly circles) in great perfection. I have also made similar compound plates of borax, nitre, and citric acid, and found them to give similar results. H. G. MADAN

Eton College, August 24

## The August Meteors

BETWEEN August 4 and 20, 174 shooting stars were recorded here in $16\frac{1}{2}$ hours of observation. These included about 37 Perseids, chiefly seen on August 5, 8, and 13, but the shower was not well observed owing to cloudy weather. The following are the chief radiant points determined from the paths registered :—

| No. | Epoch August | Radiant $\alpha$ $\delta$ ° ° | Notes |
|---|---|---|---|
| 1 | 16–20 | 5 + 12 | Meteors bright, max. Aug. 20. |
| 2 | 13 | 51 + 58 | Perseids. |
| 3 | 4–17 | 292 + 52 | Near $\chi$ Cygni. |
| 4 | 5–13 | 296 ± 0 | On equator near $\eta$ Aquilæ. |
| 5 | 5–20 | 317 + 22 | Meteors slow and faint. |
| 6 | 8–17 | 318 − 9 | Slow, S.W. of $\beta$ Aquarii. |
| 7 | 15–17 | 328 + 27 | Slow, faint. |
| 8 | 11–15 | 329 + 8 | Slow, bright, E. of $\epsilon$ Pegasi. |
| 9 | 16–20 | 345 ± 0 | Rather swift, bright. |
| 10 | 8–20 | 345 + 53 | Very swift, short. |
| 11 | 16–20 | 351 + 38 | Swift, E. of $o$ Andromedæ. |

Many other shower centres were less distinctly shown. Nos. 4 and 9 fall exactly on the equator, and were sharply defined.

As to the shower of Perseids on August 10, I believe it was more brilliant than usual, though I made no regular observations on that night this year in consequence of overcast sky. Many meteors were, however, noticed in the clear spaces which now and then occurred, and judging from the frequency of the apparitions the display was a fine one. As to the duration of the shower it was still visible, though very feebly, on August 20, for I registered 2 undoubted Perseids during a watch of $3\frac{1}{4}$ hours, when 31 meteors were recorded.

With regard to the minor displays of this epoch they are more remarkable for their number than for individual intensity. The most active of these radiants, as recently observed, was No. 10 at 345° + 53°, which supplied about 10 meteors, but the rate was less than one per hour, so that it cannot be ascribed much importance. W. F. DENNING

Bristol, August 25

## Disinfection of Sewers

IN the last number of the *Lancet* (August 15, 1885) I have read of the measures taken by the Metropolitan Board of Works for the deodorising and disinfecting of London sewers. Between 30,000 to 40,000 tons of sodium manganate and from 10,000 to 12,000 tons of sulphuric acid are daily poured in the London sewers.

[illegible] what experiments has it been ascertained that the quanti[illegible]ants used are sufficient, and how is it proved that [illegible] been properly disinfected?

I need not point out the difference between the deodorising and the disinfecting of sewage. The latter may be perfectly deodorised, and yet be quite adapted to favour the vegetation of bacteria.

The oxidising and deodorising action of sodium manganate cannot be sufficient to prevent bacterial life, unless when the salt is present in large quantities. Considering the enormous volume of London sewage, it is not to be believed that even such a vast amount of manganate as 40,000 tons *per diem* would suffice to destroy bacterial life in the sewers.

The adding of sulphuric acid to the manganate must certainly enhance the disinfecting action of the latter. Only, I do not understand why the quantity of sulphuric acid is relatively so small in comparison with the quantity of manganate. I do not see why manganate should be used at all when sulphuric acid, a more powerful and less costly disinfectant, can be used alone.

It is well known to all who occupy themselves with the cultivation and study of bacteria that these micro-organisms do not grow well in acid media, and that the addition of acids, especially of mineral acids, checks their growth completely.

It can be said that the antiseptic action of acids is of household knowledge, for vinegar is constantly used in the preservation of animal and vegetable products. That mineral acids have a greater disinfecting action than vegetable acids is also well known, unfortunately even by dealers in vinegar, who give durability to this condiment by the addition of a tiny proportion of sulphuric acid.

It is probable that pathogenic bacteria, even more than the bacteria of ordinary fermentations and of putrefaction, are in need of alkaline media, and therefore are more sensitive to the action of acids. In the animal body bacteria invade those fluids and tissues where the alkaline reaction prevails; and it is proved that the germs of disease are easily spread by milk, a liquid generally alkaline. Moreover, it has been proved by experiments on some pathogenic bacteria that gastric juice, although of so slight acidity, easily, and sometimes effectively, checks their development.

Sewage contains all the elements necessary for the nourishment of bacteria, and its alkaline reaction renders it very favourable to their growth and preservation. Disinfection means the destruction of existing bacteria and preventing the development of newly sown bacterial germs. Therefore I am persuaded that the cheapest and more simple method for effectively disinfecting sewage is to render its reaction *permanently acid* by the addition of a sufficient quantity of mineral acid.

There are of course disinfectants far superior to mineral acids in antibacterial energy. But they are generally costly substances, that cannot be applied to the disinfection of such an enormous quantity of matter as the sewage of a town. As for cheap disinfectants, such as ferrous sulphate, ferric chloride, sodium manganate, their action is inferior to that of mineral acids. Especially of the two former it can be said that their deodorising action is due to their saline constitution, and their disinfecting action to their acid reaction.

The great difficulty in extensive disinfections is to ascertain if the disinfection has been complete—*i.e.* if the substance disinfected has been rendered unfit for the development and preservation of bacteria. Even laboratory experiments, to ascertain the *minimum* of disinfectants necessary for the destroying of bacteria, are not easily conclusive. But, in using acids, the disinfection can be considered complete when a permanent acid reaction is obtained.

I do not believe the quantities of sulphuric acid poured in the London sewers sufficient to give a permanent acid reaction to the sewage. Disinfection must be done completely, or not at all: there are no half measures in disinfection. Therefore I maintain that the London disinfection is useless, and the sewage remains likely to become the culture fluid of infectious germs, unless the sewage is rendered permanently acid. All the sodium manganate added to a sewage that remains alkaline, gets decomposed; the manganese precipitates as sulphide, or is deposited in combination or mixture with the organic sediment. The sewage will thus be cleared and deodorised for a while; but it still contains in solution all the elements necessary for the nourishment of Bacteria, and is still favourable to their growth and preservation. The disinfecting action of sodium manganate would avail only if large quantities of the salt remained dissolved in the sewage, over and above of the quantities decomposed in deodorising and clearing the putrid fluid.

It might be objected that, even if mineral acids stop the development of bacteria—a point that cannot be doubted—they may not kill the spores, thus permitting the germs of disease to escape. There are no experiments (of which I am aware) to answer this objection. But there is reason to believe that pathogenic germs do not resist for a very long time when in unfavourable media; even in sewers, that are not over-filled and stagnant, and that are well ventilated, infection does not easily linger. If inside the sewers disinfection is complete, and bacterial growth checked, and all disease germs rendered inactive, until carried for away from all populous centres, I think we can leave it to air, and to the other natural agents, to ultimately destroy the surviving germs, or completely alternate their pathogenic qualities.

Amongst the mineral acids, hydrochloric would, of course, be the cheapest. But I think sulphuric acid ought to be preferred, nitric acid being too costly and too corrosive. Sulphuric acid does not attack easily calcareous cements; and if the sewers have their walls well plastered, the action of a *slight excess* of sulphuric acid in the sewage would be very slight indeed. Cements, more resisting than plaster, could be prepared. Moreover, if some portions of teh sulphuric sewage get carried in the air, or are dried in the higher parts of the sewers, the germ-laden particles do not rid themselves of the acid by evaporation; on the contrary, the acid becomes more concentrated and active, and finally must disorganise and destroy the noxious germs. This is very important in preventing the effects of sewage air.

Since 1881 Prof. Beilstein of St. Petersburg (NATURE, vol. xxiii. p. 394), experimentally concluded that sulphuric acid is the best disinfectant, although he did not advise its use because of its corrosive action. Strange to say, Beilstein thought that, practically, aluminous sulphate was to be preferred to the free acid.

It is not only during the fear of cholera invasions, but at all times, that I would wish the sewage to be *slightly* acidified with sulphuric acid. Strict supervision should be maintained over all the sewers, to ascertain that the whole mass of flowing sewage is permanently acid. I am persuaded that this simple mode of disinfection would diminish considerably many infectious diseases.

During the cholera epidemic of 1884, in Naples, I did my best, in a series of letters I then published, to persuade the sanitary authorities of this mode of disinfection. But a strange confusion of ideas was then prevalent in Naples. Through the goodwill of Prof. Cantani, Member of the Sanitary Commission, some trials of the method I proposed were done, but not in a complete and systematic manner. Such experiments cannot be done easily in Naples, and the results cannot be conclusive until the system of sewers is in good working order. Indeed, in some parts of the soil of Naples it is difficult to know if there is more sewage inside or outside the sewers. It is no easy problem to disinfect and cleanse such an impure soil, and it is indeed to be wondered that the ravages of cholera were so limited in 1884.

My letters caused sulphuric acid to be used abundantly in the sewers and *pozzi neri* of Portici, Castellamare, Taranto, and, I believe, in other places; but this, like all other disinfections, was done under pressure of approaching cholera, and abandoned as soon as the danger passed, no observation being made to measure the influence of the sanitary method adopted on local infectious diseases. The defective system of sewers and of drainage in many Italian towns renders thorough disinfection scarcely possible, and prevents precision in testing any kind of disinfection.

In English towns sewers are generally well arranged, and often well ventilated; and vital statistics have taken sufficient development to permit the testing of sanitary reforms. When it is proved (and I think the proof can be easily given) that the present systems of sewage disinfection are not sufficient to prevent *entirely* bacterial development in the sewers, these systems cannot be considered good. I venture to hope that beneficial results would soon become evident if the sulphuric acid disinfection of sewage were thoroughly applied in English towns.

Portici, August 20 ITALO GIGLIOLI

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### Ozone at Sea

THE presence of this element in the atmosphere is alleged to be indicative of its healthiness, and it has been *investigated on land* frequently by observers with varying and uncertain results.

Records of its presence may be seen daily in the *Times*, furnished from the Observatory on Ben Nevis, but as yet little notice has been taken of its *prevalence at sea*, though it has been supposed to be more plentiful there than on land.

During a voyage around the United Kingdom on the s.s. *Ceylon* in August last, we entered into the investigation of its existence at sea, and used Moffatt's papers for the purpose, obtained from Negretti and Zambra. They were exposed in a perforated light wooden box, hung up in the open air on the deck of the ship in the shade, and noted and changed twice a day.

It was found most prevalent in *Cork Harbour* (4), less so in Bantry Bay (2) and Oban Harbour (2), and nearly absent in Kingstown Harbour (1) and Leith Roads (1).

In the open sea it was most shown in the *Irish Channel* (4) and off the Lands End (4); next in the North Seas (3) and in the English Channel (2), and least in the Irish seas (1) and western coasts of Scotland (1).

Ozone was found to be indicated in greater intensity during the prevalence of *westerly winds* in the English and Irish Channels, and Atlantic seas and Dutch seas, and less with *easterly* winds prevailing in the Irish seas, Firth of Forth, and west coasts of Scotland.

The *velocity* of the winds seemed also to create a higher manifestation, as was seen during the gale from the south-west in Cork Harbour and the fresh north-westerly breezes on the south coasts of Ireland and east coasts of England. None, however, of the observations approached those registered in the *Times* from Ben Nevis (8-9), which amounted to double those noticed in the seas around our coasts during the same period (August), supposing that the same papers and scale (Moffatt's) were used for both sets of observations.

Ozone was also found to exist in the *cabin of the ship* both day and night, but at a half intensity to that on the deck, due probably to the great difference in the movement of the air in the two places.

The degrees of manifestation of ozone at sea here shown by no means come up *to expectation* that it prevailed in all its potentiality on the ocean, but of course a whole year's observation would be required to enlighten the subject and furnish a comparison with that on the land.

Again, it may be possible that *altitude* may have something to do with its prevalence, more or less, as it appeared more on the top of Ben Nevis than on the level of the seas of the same coasts near it and at the same period of the year (August).

Should this idea be of any significance it might be as well to search for manifestations of ozone at the base as well as on the top of mountains, and if similar results followed to these here pointed out it would establish the *reputation of high* level sites for great salubrity of atmosphere. W. J. BLACK

August, 1885

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## THE INTERNATIONAL BOTANICAL AND HORTICULTURAL CONGRESS, ANTWERP, 1885

THE International Botanical and Horticultural Congress met at Antwerp on Sunday, August 2, in the hall of the Artistic, Literary and Scientific Club, the opening meeting being honoured by the presence of a good many ladies. The gathering was a representative one, and included many well-known European botanists and horticulturists. The Burgomaster of Antwerp opened the proceedings with a few appropriate remarks, and Prof. Ed. Morren, of Liége, having been made President of the Congress, took the chair, and a discussion was held on the flora of the Congo. After a short discussion the meeting adjourned to the Exhibition building, where the International Horticultural Show was being held, and which was formally opened at one o'clock. Many of the plants exhibited were of great interest, and the whole of the collections were nicely and artistically arranged. At five o'clock the Congress visited the Plantin Museum, the old printing office of the Plantin Moretus family. The Museum is full of interest, [illegible] which the works of Lobel, [illegible] doubly interesting to all [illegible] of the Burgomaster of [illegible] off for the members of [illegible] presented [illegible]

In the evening there was a concert in the garden of the Exhibition in honour of the members of the Congress.

During Monday, Tuesday, and Wednesday the two sections of the Congress—the Botanical and Horticultural—met in the Botanic Garden in the upper and lower halls of the Botanical Institute. The different subjects contained in the programme were duly discussed, and a resolution of Congress on the different points raised terminated each discussion. The method adopted at these meetings was one which might well be followed in other assemblies, and is one which reflects great credit on the President of the Organisation Committee, M. Charles de Bosschere. All the subjects to be discussed were treated of in longer or shorter papers, all of which were printed in the four fasciculi of the *Preliminary Reports* issued to the adherents of the Congress. In this way all the members had the subjects before them in a tangible form, and discussion was easy. Might not the British Association take a hint from this? Without giving up the method at present followed, let the British Association add to their work a discussion on one or two subjects of importance, papers by special men to be printed beforehand, so as to be in the possession of those who can discuss the subject at the meeting.

The subjects of discussion—twenty-two in number—were mostly of considerable botanical interest, others being purely horticultural, the question of the Congo being general. Perhaps the most important subjects were the discussions on botanical laboratories, on the amount of instruction in cryptogams to be given in different parts of the botanical course of study and the recent progress of botany in different countries. It is important to notice that the general opinion of the Congress was in favour of two kinds of botanical laboratories, those of instruction and those of research, and there can be no doubt that in every society research should be encouraged in every way and be the highest object of their organisation.

On the evening of August 3 the Burgomaster of Antwerp held a reception at the Hôtel de Ville, which was very largely attended by the members. On the evening of August 4 Dr. Henri Van Heurck, the Director of the Botanic Garden, gave a most interesting series of microscopical demonstrations in the meeting-room of the Botanical Section. The application of the electric light to microscopic work was shown, and nothing could exceed the perfection of the arrangement employed by Dr. Van Heurck. *Surirella gemma*, *Amphipleura pellucida*, and Noberts's 19th band were shown in a manner which left nothing to be desired; and in the case of Amphipleura, not only were the striæ shown as distinctly as one is accustomed to see them in *Navicula rhomboides*, but, by illumination through the object-glass, the striæ were distinctly resolved into beads; by oil-immersion lenses, of which, as of other object-glasses by all the best makers, Dr. Van Heurck possesses a remarkable series. The electric light employed is obtained by a bichromate battery (Trouvé's) and Dr. Helot's photophore. As the photophore works equally well with an accumulator, and where there is no difficulty in getting the accumulators charged, no better illumination can be got, and this I would strongly recommend to all microscopists. Altogether Dr. Van Heurck's demonstration will be remembered as one of the most interesting things connected with the Congress. On the evening of Wednesday there was a grand banquet, when the members spent a very pleasant evening together.

On Thursday morning the Congress left by train for Brussels. On arrival, the members went to the Natural [illegible] Museum, and were shown through the building [illegible]tor, who kindly admitted the members of the [illegible] early hour. Next, the party proceeded [illegible] where they were received by Prof. [illegible]erbarium, museum, garden, and hot-houses were all inspected, and then the Members of the Congress were entertained in the orangery of the garden to a luncheon given by the Members of the Royal Botanic Society of Belgium. After luncheon the party proceeded by tramway to Laeken, to visit the Winter Garden, which had been opened to them by his Majesty the King of the Belgiums. Mr. Knight, the Inspector of the Royal Gardens, accompanied the party, and pointed out the objects of interest. Friday was to be devoted to an excursion to Ghent, and Saturday to a botanic excursion in the neighbourhood of Herrenthals, Dolen, and Gheel, where the Members of the Congress were to disperse. I left the party at Brussels, spending Friday at Liége with Prof. Morren, who showed me the splendid new laboratory in the pretty little garden under his charge. I afterwards visited Prof. Suringar at Leyden, and saw some of the treasures he has just brought back with him from the Dutch West Indian Islands, where he has been able to make extensive botanic collections of living and dried specimens.

W. R. McNab

August 31

## THE FAUNA OF THE SEA-SHORE[1]

THE marine fauna of the globe may conveniently, in the pursuit of certain lines of scientific study, be divided into three groups according to the regions inhabited by it. There is the littoral fauna comprising the animals inhabiting the sea-shore and the shallow waters in its immediate neighbourhood, the deep-sea fauna, and the pelagic fauna, the latter occupying the surface waters of the ocean. Each of these regions presents certain marked peculiarities of conditions of existence, and exhibits, in accordance with these, certain special characteristics in the composition and history of the origin of its fauna. The deep-sea is devoid of sunlight and therefore of plant life. It is dark, cold, and monotonous, being devoid of day and night and periodical or irregular changes of any kind. Its habitation probably dates from no very great antiquity. The ocean surface can support only a peculiar fauna of animals adapted for floating or constant swimming, and affords no shelters nor resting-places.

As Prof. Lovèn writes[2]: "The littoral region comprises the favoured zones of the sea, where light and shade, a genial temperature, currents changeable in power and direction, a rich vegetation spread over extensive areas, abundance of food, of prey to allure, of enemies to withstand or evade, represent an infinitude of agents competent to call into play the tendencies to vary which are embodied in each species and always ready, by modifying its parts, to respond to the influences of external conditions." It is in this littoral zone where the water is more than elsewhere favourable for respiration because of its aëration by the surf and where constant variation of conditions is produced by the alternation of the tides that the ancestors of all the main groups of the animal kingdom came into existence, and all the primary branches of the animal family tree first commenced to grow. It is here, probably, that the first attached and branching plants were developed, thus establishing a supply of food, and rendering possible the colonisation of the region by animals.

The animals inhabiting the littoral region are adapted in most various ways to withstand and endure the special physical conditions which they there encounter—the action of the surf, the retreat of the tides, the numerous enemies. Either they burrow deep in the sand, or cling tight to, or even bore into, the rocks, or develop hard shells or skeletons, or protect themselves by other modifications. Probably all hard shells and skeletons of marine invertebrata have thus originated in the littoral

[1] A Friday evening lecture at the Royal Institution, delivered January 23, 1885, by Prof. H. N. Moseley, F.R.S.

[2] "On Pourtalesia, a genus of Echinoidia." by Sven Lovèn. (Stockholm, 1883, p. 86.)

zone for purposes such as these. It is found that these hard structures tend to degenerate and disappear both in the pelagic and deep-sea regions.

It is a most remarkable fact that almost all these shore animals in their early development from the egg pass through free-swimming larval stages which are closely alike in form for very widely different zoological groups. As a familiar example may be taken the case of the common oyster. The egg of the oyster develops into a peculiar free swimming larva known as a Trochosphere. It is globular in form and divided by a transverse band of cilia into a smaller anterior and larger posterior area. The mouth opens just behind the ciliated band. The larva swims actively by means of its cilia. After a time it develops a pair of shells, and becomes metamorphosed into an oyster, and attaches itself immovably by one of its shells to the sea-bottom. Its shells increase in size and thickness, and form a protection against its enemies. This same trochosphere larva is common to a very large number of Mollusca of all varieties and shapes in the adult condition, and an essentially similar trochosphere is common to a large number of annelids. It is most remarkable that there should be so close a resemblance between the larva of two adult forms so widely different in all respects as an oyster and a worm. An old explanation of such facts was that such actively-moving larvæ were contrivances for procuring the wide diffusion of sedentary or less active adult forms, which might thus be conceived as of later origin than the forms themselves. But if this were the case, it is inconceivable that having arisen from so widely different starting points, the larvæ should have attained so closely similar a structure. The only real explanation of the matter is that the common larval form represents a common ancestor, from which the various adult forms, of the existence of which it is now only a phase, diverged. There was thus a common freely-swimming ancestor of the annelids and molluscs, and it seems probable that the entire littoral fauna must have been derived originally in remote ancestry from small primitive and simply organised free-swimming ancestors. All evidence seems further to point to the conclusion that the primitive ancestors of all plants were also free-swimming. The free-swimming ancestral representatives of life no doubt partly inhabited the open sea, leading a pelagic existence, partly swarmed in sheltered bays and pools on the coasts, as the larvæ of the littoral animals do now. The free-swimming plants probably produced attached descendants, and subsequently the shores, and the animals, finding there a supply of food, gradually adapted themselves to the more complicated conditions of shore life. The late Prof. Balfour[1] in his far famed work on "Embryology," in discussing the character of larvæ of the kind under consideration, speaks of them as possibly reproducing the characters of some ancestral forms "which may have existed when all marine animals were free swimming."

A peculiar instance in which there can be but little doubt, is that of the common barnacles. These in the adult condition are firmly fixed to supports of various kinds, and withstand the most violent action of the surf. The common acorn barnacles cover the most exposed bare rocks of our coasts, where the waves are heaviest, and nothing else can live. They have developed the strongest of shells to protect themselves. In the young larval condition, however, they are actively free swimming larvæ of typical crustacean structure, evidently adapted for pelagic existence, and to be found in swarms at the sea-surface, actively engaged in it. They attach themselves, and become immovably adherent and sedentary, and invested by a shell. There can be no doubt in this case that the locomotive larva represents the ancestral form, for allied crustacea still exist in abundance as adults.

A most important instance is that of the Echinoderms, the adults of the various groups of which, the sea-urchins, starfish, brittle stars, holothurians, and crinoids are most widely different in form, and adapted in most various ways to shore life. Yet these all pass through free-swimming larval stages which are most remarkably similar. Supposing the adult forms to have been antecedent, it is quite impossible that a series of larvæ could have been developed independently from starfish, echini, holothurians, and brittle stars, and have attained this remarkable coincidence of structure. This common larval form must represent the ancestral condition, the free-swimming pelagic ancestor from which the echinoderms have sprung.

The fixed and inert sponges are developed from free-swimming ciliated larvæ, and Prof. W. J. Sollas[1] has observed that the young larvæ of the sponge *Oscarella lobularis* are retained longer within the parent in the case of specimens occurring on the coast of Brittany than in that of specimens found in the Mediterranean. He attributes this difference to the influence of the presence and absence of tides in the latter case. The larvæ have come to be longer retained where the risk of their loss by current and tide is greater. By the gradual action of similar influences, no doubt, the loss of larval stages in so many instances has come about. It is probable that there is a special tendency to such loss in the case of deep sea animals. Hoek[2] has recorded the loss of the nauplius stage as a free-swimming one in the case of a deep-sea scalpellum from a depth of 500 fathoms.

One of the best examples of the special adaptation to modification of animals sprung from pelagic ancestors to littoral existence is that of the Madreporarian corals, the far famed builders of reefs. Each coral colony is sprung from a locomotive planula larva, swimming by means of cilia. The larva attaches itself, and developes into a polyp, and acquires a hard skeleton, and by budding produces a large colonial stock. The massive stocks thus formed and strengthened form reefs which are barriers to the waves. They flourish in the water churned by themselves into surf, and thus specially aerated and fitted for their respiration, and between their branches and interstices they obtain the fine pelagic animals on which they feed from the surface water. Probably the advantages thus gained is the cause of their assumption of the colonial form and development of their stout and massive skeletons. Possibly this is the reason why scarcely any colonial Madreporaria occur in deep water, although other colonial animals are abundant in the depths.

The origin of the Vertebrata is a complex question, but they are probably sprung from a very simple free-swimming ancestor, as is shown by the survival of a simple ciliated [illegible] early stage in the developmental [illegible] Amphioxus [illegible] exactly similar developmental history of [illegible] the oyster, and the [illegible] stage pre-[illegible] the echinoderms, and the characteristic [illegible] a wide range of other forms, and occurs in [illegible] Amphioxus, one of the most interesting components of the fauna of the coasts, one of the most primitive of vertebrates now existing. The Ascidians, which are in the adult condition as inhabitants of the coast, more inert [illegible], extreme instances of degeneration, are derived from free-swimming larvæ of pelagic habits which show distinct vertebrate structure and have myelonic eyes, which, as Prof. Lankester has pointed out, could only have originated in an animal of pelagic habits. The Ascidians, before reaching their vertebrate larval stage, pass through a gastrula stage like Amphioxus. It is possible, therefore, that their ancestors have twice taken from pelagic to littoral existence, having relinquished the shore for a period after their first experience of it, and returned to it again, whilst some of their close allies, such

[1] F. M. Balfour, "Treatise on Embryology," vol. ii. p. [illegible].

[1] W. J. Sollas, [illegible], 1884, p. [illegible].

[2] Report on the Cirripedia, "Challenger" Report, Zoology, vol. viii. p. 75.

as Appendicularia, have never resought the shore, and consequently have never degenerated to qualify for littoral life. The peculiar breathing apparatus adopted by the vertebrata occurs nowhere else in the animal kingdom except in the extraordinary worm-like Balanoglossus. The apparatus, as is well known, consists of a series of slits, opening from the exterior at the sides of the fore part of the body directly into the throat, the anterior part of the digestive tract. The water to be respired is taken in at the mouth and ejected through the gill slits. The late researches of Mr. W. Bateson, of Cambridge, have shown that Balanoglossus, besides breathing by gill slits, shows many other remarkable affinities, both in structure and development, with the vertebrata. Now, Balanoglossus, a shore-inhabiting form which lives buried in the sand, is developed from a most remarkable larva known as Tornaria, which is intermediate in form between a Trochosphere and a star-fish larva. It is quite possible that this extraordinary larva Tornaria may point to the former existence of a primitive pelagic ancestor common to the Annelids, Echinodermata and Vertebrata. Possibly the use of gill slits as a respiratory apparatus first arose in a shore-inhabiting ancestral form, such as Balanoglossus, and hence their presence at the anterior extremity of the body, that nearest to the surface when the animal is concealed in the sand.

It appears not impossible that Amphioxus may once have possessed a larval stage somewhat resembling Tornaria, following on its gastrula stage, and has lost it just as one species of Balanoglossus has lost the Tornaria stage. The developmental history of only one species of Amphioxus is as yet known, and investigation of that of other species may yet reveal something of the kind suggested.

The littoral zone not only became itself stocked with an immense variety of specially adapted inhabitants, but has given off colonists to the three other faunal regions. The entire terrestrial fauna has sprung from colonists contributed by the littoral zone. Every terrestrial vertebrate, every frog, reptile, bird, and mammal, bears in its early stages of development the gill slits still perforating its throat as in its aquatic ancestor. The tadpole still uses them when young for breathing, though they close up completely in the adult frog and in all the higher vertebrates before birth. In some of the tailed Amphibia, like the Axolotl, the breathing is by external gills and also by lungs which are modifications of the air-bladder of fish. In these the gill slits remain open, although they have no longer any respiratory function. It is amusing to watch tame Axolotls when fed in aquariums with large worms. They snap the prey down hurriedly and close their mouths, but usually in a moment or two their throat begins to twitch uncomfortably as if intensely tickled, and one end of the worm appears out of one of the gill slits, and the worm soon wriggles its way out again. When the Axolotl catches it again by the free end before the other is completely out of the gill slit, and begins another attempt to swallow it, and the process is sometimes repeated several times before actual deglutition is effected. The gill slits are evidently a considerable inconvenience to the Axolotl. The frog is much better off in having them closed, but man himself is not in a position ... to despise the Axolotl: his lungs are derived ... same source originally, namely, modifications of ... der of a remote aquatic ancestor, an inhabitant ... st, and they open into the throat just behind ... In man there is a lid to close this opening ... ce to pull it under the tongue when ... ce; but every one knows the agony ... rumb the wrong way—an accident ... of the Axolotl, and similarly ... le passage for two different ... tion. At such moments of ... ned to turn traitor and long that he had been produced in accordance with the hypothesis of special creation rather than evolved under the laws of natural selection. The existing arrangement must not be regarded as of inevitable necessity. The vertebrates are the only animals which breathe through their mouths. All other animals have separate passages for respiration and feeding. The common snail has a separate breathing passage completely apart from its mouth, the land crab breathes by openings at the bases of its legs, the scorpion by openings on its abdomen, and the insect by numerous apertures on the sides of its body. All these animals cannot, like man, choke themselves.

Only the pentadactyle vertebrata have adapted themselves completely for terrestrial respiration, but several fish have, by special modification of their gills, become able to remain out of water for almost indefinite periods. Most remarkable amongst these is Periophthalmus, one of the Gobiadæ inhabiting mud flats on the sea-shore in Australia, Ceylon. Fiji, and other eastern tropical regions. It hops along the mud with the greatest agility and so fast that it is most difficult to capture, and even refuses to take to the water when driven to it, skipping along its surface, and resting on projecting stones. It even climbs high up the mangrove trees and sits on the branches. All modes of air-breathing are derived by modification from aquatic breathing apparatus, except, perhaps, in the case of the air-breathing tracheata, the insects and their allies, in the ancestor of which, represented by Peripatus, the respiratory tubes or tracheæ were probably first formed as modifications of skin glands.

Littoral animals of most various kinds have taken from marine to terrestrial life no doubt by gradual adaptation, owing to exposure by the tides. Crustacea seem to have the greatest power of thus adapting themselves to aërial respiration by slight modification of their gill apparatus, so as to permit it to act as a lung. Nothing is more astonishing to the naturalist in tropical countries than to find large crabs amongst the vegetation far inland and high up mountains. But land crabs are not confined to the tropics: in Japan they may be met with walking across the high roads far inland, and 4000 feet above sea-level. One of the most remarkable instances is that of the cocoanut climbing crab, *Birgus latro*, which has developed, as Prof. Semper has shown, a regular pair of lungs out of the walls of its gill cavities. The animal was originally a hermit crab, but got too large for any shell, and thus developed hard plates on the surface of its body for protection instead. Close allies, but of much smaller size, swarm in some Pacific islands. They always bear shells, and carry them with them when they climb the trees and bushes. I have caught hold of the shell of one of them as it clung to the top of a branch, thinking that it was a land-mollusk, and have been astonished by receiving a sharp nip from a pair of claws.

The oldest-known air-breathing animals, so far as geological evidence goes, are scorpions and insects. An ally of the cockroach and two scorpions have lately been obtained from Silurian strata. The close affinities of the scorpions with the king crabs, and thus with the Trilobites, is a most interesting matter, which has lately been urged by Prof. Ray Lankester. He suggests that the lungs, by means of which the scorpions breathe air, are modifications of the gill plates of the king crab, which have become inverted for the purpose. The lung openings of Scorpio correspond with the gill plates of Limulus in position and number. Hence, possibly, the scorpions, and with them the rest of the Arachnida, are sprung from ancestral allies of the king crab and the Eurypterids, having passed from a littoral to a terrestrial existence.

It seems possible that birds were originally developed in connection with the sea-coast, and were fish-feeders. The tooth-bearing birds discovered by Prof. Marsh, such as Hesperornis and Ichthyornis, were marine aquatic birds. Hesperornis lived in a shallow tropical sea surrounding the present Rocky Mountains, then a group of islands. The modern penguins show some remarkable points of affinity to reptiles in the structure of their feet, and probably their embryonic development, when worked out, may throw much light on the past history of birds.

Some of the extinct Dinosauria which show remarkable affinities with birds were at least aquatic in habits.

The fauna of the coast has not only given origin to the terrestrial and freshwater faunas, it has throughout all time since life originated given additions to the pelagic fauna in return for having received from it its starting points. It has also received some of these pelagic forms back again to assume a fresh littoral existence. The terrestrial fauna has returned some forms to the shores, such as certain shore birds, seals, and the Polar bear; and some of these, such as the whales and a small oceanic insect, Halobates, have returned thence to pelagic life.

The deep-sea fauna has probably been formed almost entirely from the littoral, not in most remote antiquity, but only after food derived from the *débris* of the littoral and terrestrial faunas and floras became abundant in deep water. It was in the littoral region that all the primary branches of the zoological family tree were formed; all terrestrial and deep-sea forms have passed through a littoral phase, and amongst the representatives of the littoral fauna the recapitulative history, in the form of series of larval conditions, is most completely retained. It is for this reason that the researches carried on at marine laboratories on the coasts have yielded in the last few years such brilliant results.

## *BALLOON PHOTOGRAPHY*[1]

RECENT experiments in photographic aërostation, carried out by M. Gaston Tissandier, with the assistance of M. Ducom, have been attended with very complete and satisfactory results. The photograph reproduced by heliogravure in Figs. 1 and 2 was taken at an altitude of 605 metres over Paris; others which were taken did not give such perfect results; nevertheless, some of them surpass in distinctness any yet taken by the same method. The ascent took place at Auteuil on June 19, M. Ducom attending specially to the photography, while M. Tissandier looked after the balloon. The photographic apparatus arranged in the car is shown in Fig. 3. The ascent took place at 1.40 p.m. with a south-west wind. Ten minutes after starting a first photograph was taken at 670 metres; soon afterwards another was taken at about the same height, in which a bridge, quay, public

Fig. 1.—Reproduction by heliogravure of a plate taken at a heig[...] above Paris, show[...] Pont Louis Ph[...] &c.

office, fifteen cabs, a tramway, and the peo[...] streets were clearly reproduced. At 605 [...] photograph here reproduced was obtained, but [...]ately heliogravure does not produce an exact *fa*[...] the fineness of the details. The smaller plan [...] shows the exact topography of the place. Wh[...] photograph itself is examined through a magnifying [...]

[...]ils are dis[...] [...]at to the [...] [...], the ch[...] [...]ll black [...]

[1] Abstract from *La Nature*.

photographs were taken at greater altitudes—one at 1000, and one at 1100 metres. Hence in crossing Paris, between 1.40 and 2.12, or in twenty-two minutes, five photographs were obtained. It would be easy to have two or three photographic apparatus with an operator in the car for each, and thus to obtain a series of views. By this method a series of topographical documents of incomparable precision might be obtained. Amongst the views taken during this ascent those which are perfect in point of clearness are those taken at the moment when the rays of the sun fell directly on Paris. Good light is absolutely indispensable, and, in spite of the photographs being instantaneous, the car should be kept perfectly free from oscillation at the moment the picture is being taken.

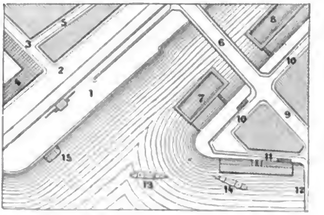

FIG. 2.—Explanatory plan of above:—1. Gate of the Hôtel de Ville. 2. Quay of Hôtel de Ville. 3. Rue de Brosse. 4. Old Lobau Barracks. 5. Rue de l'Hotel de Ville. 6. Louis Philippe Bridge. 7 and 8. Baths. 9. Rue de Bellay. 10. Quai de Bourbon. 11. Quai d'Orleans. 12. Pont St. Louis. 13 and 14. Boats. 15. Pier.

The operator and occupants of the car must at that moment remain perfectly still. The movement of the balloon has no injurious effect on the clearness of the proofs obtained; in the present instance the current of air was somewhat rapid, for the balloon traversed Paris at its greatest width, 11 kilometres, in thirty-two minutes. The rapidity of the wind increased subsequently to much more than this. After taking photographs of the earth below, the apparatus was turned upwards to obtain views

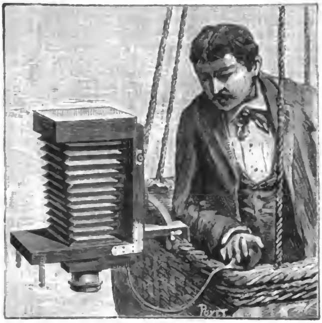

FIG. 3.—Arrangement of photographic apparatus in the balloon.

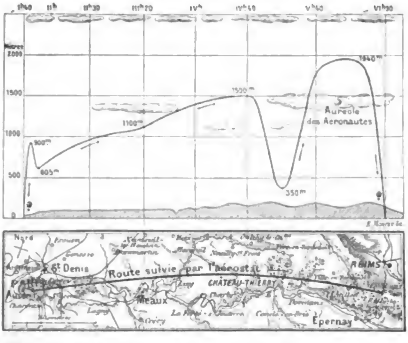


FIG. 4.—Diagram of the ascent of the "Commandant Rivière" balloon from Paris to Les Rosais, near Rheims, June 19, 1885.

...ds; but the white clouds which reflect the rays ...h great intensity, did not give good results. ... will require special arrangement for this ...ir next expedition the aëronaut-photo... ...btain something more complete than ...eir experience on the whole is that ...tained in a balloon as beautiful ...uced on *terra firma*. Thanks to the instantaneous process, to the extra-sensitive plates produced to-day, and to other modern improvements, aërostatic photography has a great future. It will give plans which will exceed in precision and clearness the most pains-taking maps; it will be a powerful ally of military art, for it will admit of obtaining a reliable plan of fortresses or of hostile works. At a height of 600 metres a balloon has nothing to fear from artillery fire, and the photographer can operate as safely in his car as in his studio. It will also add to the resources of photography, for there are no places on the earth's surface inaccessible to a balloon.

The ascent here described had for its main purpose photography; but it had also some meteorological interest. The ascent began at 1.20; and at 3.20, at an altitude of 1100 metres above Meaux, another balloon, which ascended some time after them, was met with. They were actually in a frequented aëronautical route—an aërian river. At Meaux Nadar descended in 1863; M. Tissandier himself landed at the same place in 1872, and several other descents were made there. A little farther, at Château-Thierry, on a prolongation of the line from Paris to Meaux, M. Tissandier and M. de Fonvielle made an extraordinary descent in a storm in 1869, when they were dragged along the ground four kilometres in five minutes. They travelled from Paris to Château-Thierry, a distance of 80 kilometres as the crow flies, in 35 minutes—the most rapid balloon voyage on record. On the present ascent, at an altitude of 1000 to 1400 metres, an aerial current of considerable speed prevailed; it was estimated at about 40 kilometres an hour. At 1400 metres a mass of white translucid clouds stretched across the sky and floated in the upper part of the aërial current. Above this, again, the air was calm; small white clouds remained immovable at 2000 metres, and the sun was very hot. After having descended close to the earth above Château-Thierry, it was decided to rise above the clouds amongst which the aeronauts had just been. At 6 o'clock, at a height of 1900 metres, they observed the shadow of the balloon projected on a white ground of clouds; the latter formed a small greyish circle, surrounded by an aureole of the seven colours of the rainbow. When they approached the clouds, it was only the shadow of the car and of the lower part of the balloon of which the projection could be distinguished, and the aureole assumed a larger diameter. This remarkable and beautiful phenomenon resembles that of the spectre of the Brocken. At 6.10 the descent commenced; the balloon crossed the bank of clouds, and the surface of the earth, when it came in sight, looked grey and dull compared with the magnificent regions of the upper atmosphere.

## *RADIANT LIGHT AND HEAT*[1]

### III.

*Radiation and Absorption—Terrestrial Applications.*

HAVING now established the Theory of Exchanges, let us inquire at greater length into the nature of the radiation from bodies of different kinds. For this purpose we shall adopt the well-known classification into solids, liquids, and gases, and shall select as the type of a solid body (as far as radiation is concerned) a black substance like carbon. We must do this because, in order to obtain the greatest amount of radiation from such a body at a given temperature, it must be of sufficient depth to be practically opaque, or *athermanous*, for the heat of that temperature, and it must have a non-reflective surface. Now carbon or lamp-black possesses these properties, if not completely, yet to greater perfection than any other substance that we know of; and on this account we shall select it as the type of radiating solid bodies.

Then as regards liquids, we have no doubt an amount of surface-reflexion, which will have the effect of diminishing the radiation, and also of polarising it, to some extent. In this respect a liquid surface may be regarded as equivalent to a polished solid surface, so that liquids and polished solids may be classed together as giving out an amount of heat somewhat less than that given out by the typical black surface.

But while there is no marked distinction in radiation between solids and liquids, if only the depth of substance be sufficiently great, the radiation of gases is essentially different. This difference consists in the fact that while solids and liquids radiate all kinds of heat possible to the temperature, gases radiate only a few. We shall best perceive this distinction if we confine ourselves to rays which affect the eye, and view these by means of the spectroscope.

We have already explained how this instrument draws out a thread of white light into a parti-coloured ribbon, red at the one end and violet at the other. Now if our thread of white light be a thread of platinum, or, better still, of carbon rendered incandescent by means of electricity, we shall no doubt obtain the spectrum above mentioned. But if our source of light be a row of incandescent gaseous particles, we shall obtain something very different. Instead of a long, continuous, variously-coloured ribbon, we shall have a few discontinuous threads of light emerging from a dark background, each such thread or image having of course its proper spectral position; that is to say, if the gas gives out a yellow ray, this will appear in the yellow region of the spectrum; if a red ray, in the red region, and so on. Such spectra may either be thrown upon a screen, or viewed through a telescope—sometimes it is possible to throw them upon a screen and render them visible to a large audience, but sometimes this is not possible. In all cases, however, they may be thrown into a telescope and viewed by the individual observer.

We are thus in a position to formulate the distinguishing characteristic between the spectra of solids and liquids, and those of gases, the former giving out a continuous spectrum, consisting of all the rays of light possible to the temperature, while the latter give a discontinuous spectrum, consisting of a few bright lines on a dark background.

We can, in an imperfect manner, assign a reason for this behaviour. In a solid, or even a liquid, the various molecules are near together, so that no individual is free from the trammels of its neighbour in its vibrations. On the other hand, it is not so in a gas, or at least in a gas of which the molecules are very far from one another.

Here one individual is for the most part of its existence free from the trammels of its neighbours, and is able to vibrate after its own fashion and in a way to suit itself, just as freely as a bell, or the string of a musical instrument. It thus gives out, as it were, its own peculiar note, or series of notes, these notes being here, however, rays which have a definite place in the spectrum, instead of sounds which have a definite place in the musical scale. But whilst there is a great amount of freedom amongst the molecules of a gas, we must not carry this conception of things too far, or suppose that in a compound gas at ordinary temperatures we have nothing but a series of perfectly similar molecules practically independent of one another.

The particles or molecules of such a gas are far from being in a state of rest, and we may imagine them to be running about in straight paths, except when they are deflected by dashing against a neighbour, or against the sides of the containing vessel. It will thus be seen that the molecules are not quite free. In fact, a molecule perfectly remote from neighbours, travelling, for instance, in free space, and remote from the sun, would have no more inducement to vibrate than a bell would have under similar circumstances. It is the collision with its fellows that will generally cause it to vibrate, but [illegible] sufficiently independent to vibrate according to its o[illegible] Indeed, we are in a position to assert that a g[illegible] energy which constitutes ordinary heat [illegible] from this motion of the molecules in [illegible] again, th[illegible] of the gas is [illegible] of the [illegible] one [illegible]

[1] Continued from page [illegible]

Now in a compound gas these collisions sometimes cause dissociation of the compound molecule into more elementary constituents, which constituents will probably afterwards combine again, so that we may imagine that in such a gas (see "Heat," by Prof. Tait, page 203) equilibrium is maintained by a constant amount of dissociation, accompanied by an equal amount of recombination. It is thus apparent that we have not here perfect simplicity and uniformity of molecular structure, and without discussing the question whether a simple molecule might or might not be expected to vibrate in only one way, we can readily imagine that the spectrum of such a gas should present us with more than one mode of vibration; that is to say, more than one spectral line.

Again, circumstances which conduce to proximity of molecules, and to the action of molecules upon each other, tend to bring about a state of things similar to that which we have in liquids and solids; that is to say, they will favour the emission of various kinds of rays, while on the other hand, the characteristics of a gaseous spectrum will be best shown by a perfect gas, that is to say, by a gas which is far removed from any tendency to condensation. A rare gas at a high temperature will possess these properties.

Having now defined the characteristics of the spectra of solids, liquids, and gases, let me say a few words about the methods by which we obtain gaseous particles heated to a high temperature. These are obtained in two ways. First, by means of flames, such as that of a Bunsen's burner, into which the particles are introduced. In such flames we may imagine that we have before us a certain number of the particles of a certain gas all, or nearly all, heated to a temperature somewhat approaching that of the flame. The substance will probably have been introduced into the flame in a different chemical state from that in which it appears in giving out the light; for instance, we may introduce into a spirit-lamp a little chloride of sodium, or into a Bunsen's burner a little bicarbonate of soda. The flame becomes immediately of a yellow nature, giving us the double line D, or the yellow line of incandescent sodium vapour, and this affords us evidence that dissociation has taken place. In like manner the red line produced by salts of Lithium, the green line produced by those of Thallium, and so on, are indications that the compound saline molecules have become dissociated in the flame.

The second way of producing gaseous spectra is by an application of electricity, as when a high tension spark is sent through a tube containing a small quantity of a given gas, or a vacuum tube, as this is sometimes called. We have then a momentary flash, consisting of the rays which characterise the spectrum of the gas through which the discharge has passed. It is probable that in this case only a portion of the particles filling the tube have been brought to the high temperature which is denoted by the discharge.

Before proceeding further, it may be well to mention that while from the title of our subject we must necessarily consider the spectrum to some extent, yet this is not to be regarded as a treatise on the spectroscope and its applications, which formed the subject of a previous set of essays in the NATURE Series by Mr. Lockyer. We shall discuss the subject in a somewhat different manner, and also give more especial attention to those branches which had not yet been developed when Mr. Lockyer wrote his work. With these preliminary remarks, we shall divide the subject before us into two sections.

(1) Radiation and its consequences.

(2) Absorption and its consequences.

In the first we shall discuss radiant spectra to a con-[illegible]derable extent, but shall not entirely confine our remarks [illegible] these phenomena; while in the second we shall dis-[illegible]sorption spectra to a considerable extent, but [illegible]ntirely confine ourselves to spectral absorption.

There is likewise another convenient way of dividing our subject, namely, in its application to terrestrial and celestial phenomena.

Combining, therefore, these two principles of subdivision, we shall, in the first place, treat of terrestrial applications of the laws of radiation and absorption, and in the next place of their celestial applications; and, finally, we shall discuss the light which both of these branches together appear to throw upon the ultimate constitution of matter.

With regard to our own Earth, it is abundantly evident that the great bulk of the heat which it receives is from the radiation of the sun, while, on the other hand, the great bulk of the heat which it loses is through radiation into space.

There is a sort of balance kept up between the gain on the one hand and the loss on the other, in virtue of which we are placed under conditions in which life is endurable, and for the most part pleasant. The variations in these conditions in temperate latitudes may sometimes cause distress to the weak, but they are not less the source of enjoyment and vigour to the strong; and, as a matter of fact, the most energetic races of mankind are they which dwell in those favoured regions that are neither too cold nor too hot.

Inasmuch as the regions near the equator are hotter than those near the poles, it follows that there is greater radiation into space from the former of these than from the latter. If, therefore, we could imagine an observer to be placed many thousand miles above the earth, having an eye capable of distinguishing dark rays, and to regard that portion of the earth unilluminated by the sun, his eye would receive more rays from the equatorial than from the polar regions.

On the other hand, the polar regions being manifestly colder than those of the equator, we have convection currents of hot air passing in the upper atmospheric regions from the equator to the poles, and currents of cold air passing in the lower atmospheric regions from the poles to the equator. These latter are known as the Trade Winds, and the former as the Anti-Trades. In like manner we have in all probability currents of hot water passing in the upper oceanic regions from the equator to the poles, and currents of cold water passing in the lower oceanic regions from the poles to the equator. It is not, however, our object to dwell on these phenomena here; suffice it to say, that our well-being depends on the balance between the radiant heat which we receive from the sun and that which we give out into empty space.

The phenomena of dew form an exceedingly good illustration of the laws of radiation. This subject was first investigated by Dr. Wells, an English physician. When the sun has sunk beneath the horizon of any place, bodies of small mass and great radiating power for dark heat, such as the leaves of plants, become quickly cooled by their uncompensated radiation into space. They thus cool the air around them, until this air becomes so cold that it can no longer retain in the viewless state the aqueous vapour which it holds; part of this is consequently deposited in the form of dew, or of hoar-frost, if the temperature be sufficiently low.

The following are the laws which regulate the deposition of dew:—

(1) Dew is most copiously deposited under a clear sky.

(2) And with a calm state of the atmosphere.

(3) It is most copiously deposited on those substances which have a clear view of the sky.

(4) And which are good radiators and of small mass.

(5) And which are placed close to the earth.

The first of these conditions is essential, because the cooling which precedes the deposition of dew is owing to radiation into free space.

If there are clouds, these will radiate back to the body, and thus prevent it from cooling fast enough. We see, likewise, the necessity for a calm atmosphere, when we reflect that dew can only be deposited by means of the body cooling the air around it; now if this air is constantly renewed, it cannot cool this large body of air to any great extent, and hence dew cannot be formed.

It is very manifest why the body must have a clear view of the sky, and why it must be a good radiator in order to promote the deposition of dew. Also why it must not be of a great mass, for, if it were, the heat from the interior might be conducted to the surface, and thus keep up the temperature.

Finally, the substance must be near the earth, for, if not, the cooled air will fall down, giving place to warmer air. The body will thus have a larger mass of air to cool, and it will less easily succeed in bringing this mass below the dew point. I shall return to this subject at a later stage, when the part played by the aqueous vapour of the air is taken into account. Let me here state that there are regions in the earth where dew forms an important factor in agricultural operations.

The artificial warming of our rooms is at present accomplished very much by radiation. An ordinary fire of coal or wood acts by this process. The heated carbonic acid gas which is the product of the combustion is carried up the chimney and out into the air, so that all that remains to heat the room is the light and heat given out by the glowing fire.

It is by no means an economical use of heat, but there are other considerations besides those derived from economy, and an open fire will always be cherished by those nations whose social life is greatly within doors.

The burning of gas in order to obtain illumination has nothing to recommend it. As it is used at present, it gives out a great deal of heat compared to its light, as well as a quantity of carbonic acid, and other products still more deleterious.

It ought to be replaced by some kind of electric light, such as that proposed by Swan, where a thread of carbon is kept at a high temperature in a glass vacuum by means of an electric current. There the luminous effect is very large in comparison with the heat produced, besides which there is no foul air or other hurtful product.

If we regard radiation as a means of increasing our knowledge, apart altogether from its primary and indispensable action in rendering us acquainted by means of vision with the objects around us, we cannot have a better instance than that which is given us in spectrum analysis. Here, in the first place, a little reflection will convince us that we can gain hardly any knowlege by this means of the nature of a luminous solid or liquid body, for all such bodies at the same temperature will give out all the various rays which are possible to that temperature. There is, therefore, no means afforded us by their spectra of distinguishing one from another, so that spectrum analysis is here impossible.

It is very different, however, when we come to gases which give out spectra consisting of bright lines in a dark background. Here there are various laws which combine not only to make spectrum analysis possible, but to constitute it an extremely delicate instrument of research. *In the first place*, we have the law that the lines given out by any one elementary vapour are different in spectral position from those given out by any other. *Secondly*, as a rule such bright lines remain in their places throughout a great temperature range. *Thirdly*, an exceedingly small amount of the element in question is generally sufficient to produce the lines.

It is stated that by means of the spectroscope the presence of less than one two-hundred-millionth part $\left(\frac{1}{200,000,000}\right)$ of a grain of sodium may be detected. Indeed, the difficulty is to get rid of the sodium line in an insular climate like ours, surrounded by sea-water which contains chloride of sodium.

There are three chief points for consideration in the study of gaseous spectra:—

(1) The effect produced by increasing the pressure of the gas.

(2) The effect produced by giving the gas a motion to or from the observer.

(3) The effect produced by increasing the temperature of the gas.

The effect produced by increase of pressure consists in a widening of the bright lines. This subject was first studied by Frankland and Lockyer, who found that all lines are not affected by pressure to nearly the same extent. The F line produced by incandescent hydrogen was found by them to be peculiarly subject to an increase of pressure, widening out in certain cases to a really remarkable extent.

Lockyer, who has since greatly studied this subject, is of opinion that it is not *pressure per se* that is influential in thickening the lines, but rather *the frequency of encounters of precisely similar molecules*. An important application of this law of pressure has been made by Lockyer, who has for this purpose used the electric arc, placing the slit of his spectroscope so as to embrace a section of this arc mid-way between its terminals and at right angles to its length. Now in the heart or central axis of this arc the gaseous particles which give out the light may be supposed to be somewhat near together, whereas at the border or circumference they are comparatively far apart. When the spectrum of such a transverse section is taken, this is found to consist of a number of bright lines, some long and some short. The long lines are those which remain visible even when the particles are far apart, while the short lines are those which require a greater nearness of particles to come out, and are therefore confined to the central regions of the arc.

Suppose now that we take the spectrum of such an arc, from terminals composed of absolutely pure iron, and that by this means we obtain a number of long and short lines, characterising the spectrum of this metal in the state of vapour.

Suppose next that we obtain the spectrum of some other metal, such as copper, which is not chemically pure, but which, we suspect, contains a little iron. We shall obtain, of course, the copper lines well defined and intense, *plus* an indication of the iron lines; but inasmuch as the iron particles are here few and far between, the iron lines which make their appearance will be those which do not require great nearness of particles in order to come out—in other words, they will be the long iron lines, and not the short ones. In searching spectroscopically for an impurity it is thus only necessary to direct our attention to the long lines of the various metals which we suspect to be present. Thus the whole process of comparison is made much simpler, and we are enabled likewise to obtain with comparative ease the true spectra of the various elements.

Let me now say a fe[illegible] the effect produced by a motion of the [illegible] from the observer. Suppose that a tram [illegible] minutes in a certain d[illegible] briskly *towards* this statio[illegible] than every five minutes. [illegible] briskly *from* the [illegible] tly than every fiv[illegible] le of a locomoti[illegible] [illegible] second, then [illegible] in [illegible] the [illegible] advanced one inch during the time that the last blow has advanced 13 inches, and thus the distance between the two blows will be 12 inches, or one foot. If, therefore, an observer be standing on a railway platform and a railway engine be advancing at full speed whistling as it comes, the interval between the blows will be less than usual, or the note will be shriller than if the engine were at rest. On the other hand, when it has passed the station and is rapidly receding from the observer, the interval will be greater than usual, and the note less shrill.

It is precisely the same with regard to light. If a luminous body emitting rays of definite wave length be moving towards the observer, the wave length will be lessened and the ray pushed forwards to the more refrangible side of the spectrum. If, on the other hand, it be moving from the observer, the wave length will be increased, and the ray pushed backwards to the less refrangible side of the spectrum.

The only difference between light and sound is that the former moves so fast, that in order to get an appreciable alteration in wave length we must have a luminous body moving from or towards us with velocities much greater than we can produce experimentally, whereas in the case of sound we can make the experiment.

Nevertheless if we go to the surface of the sun, or to the fixed stars, we shall find luminous objects moving from or towards us with velocities sufficiently great to suit our purpose.

Let me now say a few words on the effect produced on some gaseous spectra by increasing the temperature of the gas. It is quite certain that at comparatively low temperatures such spectra are more complicated than they are when the temperature is high. In the former case they frequently present a fluted appearance, while in the latter we have spectra composed of a few bright lines on a dark background.

In some cases an increase of temperature entirely changes the character of the spectrum, so that certain so-called elementary substances may be said to have two or more spectra. In general, however, we have, notwithstanding these remarks, the great feature already mentioned of a persistence of the more permanent spectral lines, more especially in the case of metals, throughout a large temperature range.

By means of spectrum analysis we have discovered the existence of several new elementary metals, all of which are very sparingly distributed.

Bunsen was the first to detect two new elementary metals, cæsium and rubidium. Shortly afterwards Crookes discovered thallium, Messrs. Reich and Richter indium, and other elementary metals have since been discovered by the same means.

It is now time that something should be said about the phenomena of absorption. Since gases have small radiating powers, they may naturally be supposed to have small powers of absorption. We know, for instance, how feeble is the absorption of pure air for luminous rays, or even for ordinary heat rays. Tyndall has studied the absorptive power of gases for low temperature heat, and has come to some very interesting conclusions. The following table embodies the results of his experiments:—

*[illegible] absorption of various gases, each of the pressure of 1 inch.*

| | | | |
|---|---|---|---|
| [illegible] | [illegible] | Nitric oxide ... ... | 1590 |
| [illegible] | [illegible] | Nitrous oxide ... ... | 1860 |
| [illegible] | [illegible] | Sulphide of hydrogen ... ... ... | 2100 |
| [illegible] | [illegible] | Ammonia ... ... ... | 7260 |
| | | Olefiant gas ... ... | 7950 |
| | | [illegible]urous acid ... | 8800 |

[illegible] ower of the three [illegible] small, while [illegible] Tyndall imagines that the molecule of a compound gas may be more inert and less nimble in its vibrations than that of a simple gas. That is to say, the compound molecule will vibrate more slowly than the simple one, and will thus give rise to rays of great wave length; and inasmuch as its absorption and radiation are connected together, it will be peculiarly liable to absorb rays of great wave length.

Its absorption for dark heat may therefore be very great, even although it may appear perfectly transparent for ordinary light rays.

Tyndall has found, as the result of his inquiries, that aqueous vapour absorbs many more dark rays than dry air, and justly concludes that the aqueous vapour present in the atmosphere plays a very important part in terrestrial economy. Being transparent for rays of high temperature it stops but a small proportion of those which come to us from the sun; on the other hand, being comparatively opaque for rays of low temperature, it stops the radiation into space from the surface of the earth. To speak more accurately, it does not absolutely prevent this radiation, but absorbs it and returns as much or nearly as much again. Its action, in fine, is virtually the same as that of a cloud in preventing the refrigeration which accompanies dew. Tyndall remarks that in those regions where the air is very dry the nights are often intolerably cold, owing to this uncompensated radiation into space.

Such regions are those in Central Asia and the great African desert, in the latter of which water can readily be frozen after the sun has sunk. The glass of a greenhouse acts in the same way as the aqueous vapour of the air. It allows the sun's rays freely to penetrate and to heat the air within; but it stops the dark heat of the plants and of the soil from being radiated outwards into free space. Even a loose frame of glass may save the tender blossoms of the peach, and other wall fruit, from being destroyed by nocturnal refrigeration.

BALFOUR STEWART

(*To be continued.*)

## *NOTES*

On Monday Prof. Michel Eugene Chevreul entered upon his 100th year. Apart from the fact that among men whose lives have been devoted to active scientific research no one has before attained such an age, M. Chevreul stands conspicuous for the vast amount of work he has done and for the great practical effect his work has had on the industries of the world. When Dumas in 1852 addressed M. Chevreul on the occasion of handing to him the *prix* of 12,000 francs accorded to him by the Société d'Encouragement pour l'Industrie Nationale, he said:—"Le prix consacre l'opinion de l'Europe sur des travaux servent de modèle à tous les chimistes; c'est par centaines des millions qu'il faudrait nombrer les produits qu'on doit à vos découvertes." More recently, in 1873, when the award of the Albert medal was made by our Society of Arts, the terms in which the Council expressed the grounds of the award were:—"For his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world." His scientific work, apart from its commercial outcome, was in this country recognised by the Royal Society as far back as 1826, when he was elected a foreign associate. In 1857 the Copley medal was awarded to him. Other countries have also paid him honour, while the distinctions of his native land have showered upon him. Born in Angers in 1786 (on August 31), where his father was a physician of note, he was but seventeen when he went to Paris to be "manipulateur" in the laboratory of the celebrated Vanquelin. At the age of twenty he published his first chemical paper, and in the next half dozen years he had published more than a score on different subjects. Then began that series of papers (commencing in 1813), "Recherches chimiques sur plusieurs corps gras, et particulièrement sur leurs combinaisons avec les alcalis," which extended for many years and were compiled and rearranged in the volume "Les corps gras," issued in 1823 with the dedication "à Nicolas-Louis Vauquelin, mon maître." In 1824 he was appointed Professor of Chemistry at the famed factory of Gobelins, and the energy and untiring industry which was one characteristic of his work soon accumulated stores of knowledge based on experiment. "In exact experiment he [illegible] the highest importance. He wrote in 1823 "experiment is not chemistry, facts alone do not constitute that science, but we cannot have the science without exact experiment." His "Recherches sur la teinture" is an elaborate work, and his "Moyen de définir et nommer les couleurs" occupies the whole of vol. xxxiii. of the *Mémoires* of the Institut. It has often been remarked that it is difficult to believe that the Chevreul of "Corps gras" fame and the Chevreul who wrote on colours are one and the same man.

We regret to have to announce the death, on August 27, of Lieut. L. Brault, of the French navy, who had charge of the Meteorological Service at the Dépôt des Cartes et Plans, Paris. M. Brault was the author of several important meteorological works, among which may be specially mentioned one on the circulation of the atmosphere in the North Atlantic and a treatise on astronomy and nautical meteorology. But the great work to which he devoted the larger part of his energy was the preparation and publication of wind charts for the Atlantic, Indian, and Pacific Oceans, a work begun in 1869 and finished in 1880. It [illegible] large [illegible] giving for each [illegible], and for [illegible] the [illegible] wind over those oceans. At the time of his death he was employed in the extraction and tabulation of observations from ships' logs, with the view of publishing monthly charts of various elements as soon as he had collected sufficient data. It [illegible] one [illegible] man [illegible] in the midst of such useful work.

Mr. George Frederick Armstrong, M.A., F.G.S., C.E., some time Professor of Engineering in the McGill University, Montreal, and in the Yorkshire College, Leeds, has been appointed to the Regius Professorship of Engineering in the University of Edinburgh, vacant by the death of [illegible] Jenkin, LL.D., F.R.S.

The Queen has been graciously pleased to confer the [illegible] of Knight Commander of St. Michael and St. George on Mr. John Fowler, C.E.

We regret to learn that Mr. Trelawney Saunders has retired from the post of geographer [illegible] at the India Office [illegible] position which he has held with credit to himself and advantage to the public service for the period of [illegible] years.

Prof. [illegible], of Geneva, writes [illegible] *Times*, has communicated to the [illegible] remarkable atmospheric phenomenon which was noticed on August 6. Until after five o'clock [illegible] the sky had been [illegible] and serene over all the valley of the Léman, but [illegible] fire, albeit the atmosphere above the lake and neighbouring mountains remained remarkably still. [illegible] vapours were seen at a great height [illegible] by a strong and warm north-west wind in the upper air, elevating rapidly towards the north-east, and taking the undulating forms which characterise clouds strongly charged with electricity. At half-past eight the aspect of the sky had become decidedly stormy. The thick [illegible] masses were [illegible] wildly, after their general movement was still from south-west to north-east. After nine o'clock these clouds, drawing away, appeared amidst the sheet of cirrus which stretched above them. The cirrus was phosphorescent, and looked as if lighted up by a bright moon. On the north-western horizon the sky along all the chain of the Jura was obscured by thick clouds that from time to time were illuminated by flashes of lightning. It was the same over Mont Salève, above which the lightning played every few minutes. A long black cloud stretching from the Dôle to the Salève presented on one side a broad phosphorescent border, and about a quarter past nine there became suddenly visible in that part of the cloud nearest the Jura a luminous centre whence escaped two or three phosphorescent rays pointing towards the south-east. The phenomenon lasted some twenty minutes, and was sufficiently striking to be remarked by many observers. From a quarter past nine to eleven o'clock, moreover, the south-western extremity of Mont Salève was illuminated by a phosphorescent light so intense that its rays were visible from every part of the horizon. The general appearance of this south-west section of the Salève resembled that which is presented by the city of Geneva in thick weather when the mists of evening are lighted up by the gas of the streets. Some rare instances are on record of forests of resinous trees becoming phosphorescent in stormy weather; but the distance from Geneva was too great to enable observers to determine whether the light resulted from the phosphorescence of the fir trees which cover the sides of the Salève or from that of other parts of the mountain. The Central Meteorological Bureau publishes, about eight o'clock every morning daily, accounts of the general condition of the atmosphere throughout Europe, and special reports from twelve stations in Switzerland at eight o'clock p.m. and one o'clock p.m. These reports are received at Geneva on the following day, and those of August 5 and 6 show that on the dates in question there took place a complete change in the atmospheric equilibrium of western Europe, and that the high pressures which for several weeks previously had prevailed over England and the Channel suddenly ceased, and gave place to warm, vapour charged winds from the south-west.

If original scientific work has been poured forth principally in the [illegible] countries of Western Europe, it is not a small labour which America seems to be undertaking in thoroughly [illegible] and arranging in available order, not indeed the knowledge [illegible] in the confused heaps of publications [illegible] knowledge may be [illegible] extracted. Another [illegible] catalogue [illegible] compiled by Dr. H. C. Bolton appears as [illegible] of the Smithsonian Institution. [illegible] of [illegible] science, it contains a [illegible] and technical periodicals published in [illegible] the use of this literature. It does not [illegible] *Transactions* of Societies already [illegible] H. [illegible] Catalogue of Scientific Serials published in 1879. [illegible] not contain the titles of [illegible], the two [illegible] are complementary, and [illegible] valuable list to any seeking information [illegible] of [illegible] however, neither technical [illegible] Proceedings [illegible] of course, found to lack [illegible] the publications which form such an [illegible] the wealth of the United States have much assisted in [illegible] work, and it [illegible] useful to a student in apprehending [illegible] than 120 of these each publication is [illegible] good order, commencing with 1738, is also given, showing during which years each of the [illegible] was carried on, and there is provided also with an index by which the place of each in the list may be found. Another [illegible] referring the reader to the principal [illegible] adds greatly to the practical value of the whole work.

Dr. Josiah Parsons Cooke has just published a volume entitled "Scientific Culture and other Essays." [illegible]

[illegible] devastated the island, killing the sheep in [illegible] Westfjord. The fishing has been [illegible] where the herring have been plentiful [illegible]. The fish [illegible] in excellent condition.

[illegible] very unusual weather has [illegible] having fallen at several [illegible] from the Polar [illegible] Gulf Stream in the spring [illegible] large quantity [illegible] north-east of Norway.

[illegible] from North and Central Sweden [illegible] are already [illegible] in large [illegible] thousands of [illegible] their progress lasting for [illegible] the night [illegible] were [illegible] left their summer haunts [illegible]

[illegible] storm on the U.S. Atlantic [illegible] August [illegible] the mercury falling [illegible] Charleston, South Carolina, had [illegible] were blown [illegible] damaged, the wind [illegible]

Banda, and Kayeli, and on the following day at Kairata. Villages on the beach were overwhelmed by the sea. At intervals of about twenty minutes the sea receded to a distance of 300 yards from low water mark, and then returned to overflow to a depth of 34 feet the broad plain near the beach, fifteen miles west of Kayeli. This phenomenon does not appear to have been general, but to have confined itself to the locality mentioned.

EARTHQUAKE shocks were felt on August 26 in the valley of the little river Murz, in Styria. They caused no damage beyond loosening the foundations of a few cottages. Several shocks were felt in the same district last May.

THE *Nacion* of Guayaquil gives details of the eruption of the volcano of Cotopaxi early on the morning of July 23. It states that about one o'clock in the morning people were awakened by a sound as of heavy artillery fire, apparently from guns of the heaviest calibre. The explosions followed one another with wonderful rapidity, sometimes causing a continuous roar, shaking the earth and causing the windows and the doors of the houses to rattle. At Chimbo, which is situated almost at the foot of the volcano, there was what the residents along the river Vaca call an "aluvion." The phenomenon so-called is really the stream of lava which descends the mountain sides, melting the snow with which it is covered, and pouring down a tremendous mass of lava, mud, water, and all obstacles encountered in its progress. Investigations during the day showed that the shocks produced by the explosions during the night were exceedingly heavy. The smoke hung like a pall over the face of the country, and the steady fall of ashes thrown [illegible] out of the terrible crater intensified its darkness. Accounts from Latacunga state that the eruption began with a terrible storm. The damage done was considerable, but the number of victims is not known. A similar catastrophe occurred in June 1877.

THE "Bureau Scientifique Central Néerlandais," established in 1871 at Haarlem, after the death of its first Director, the lamented Prof. E. H. von Baumhauer, has been taken in hand by Dr. P. P. C. Hoek, at Leiden. The Bureau is in relation with the Smithsonian Institution, Washington, the "Ministère de l'Instruction publique en France," the "Commission des Échanges Internationaux à Bruxelles," with bureaux in Christiania, Stockholm, Copenhagen, &c. Packages sent as donation or exchange, and destined for Dutch learned [illegible], henceforth are to be sent to the new Director at Leiden to be delivered to the agent of the Bureau at London *franco expense*. The agents of the Bureau are Messrs. Williams and Norgate, 14, Henrietta Street, Covent Garden, London.

THE additions to the *Zoological Society's* Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mr. H. J. Hardisley; a Burrowing [illegible] from Mexico, presented by Mr. F. H. Harvey; a Great Kangaroo (*Macropus giganteus*) from New South Wales, presented by Mr. A. McHarrath; two Golden-crowned Conures (*Conurus aureus*) from South East Brazil, presented by Mr. Cuthbert D. Middleton; a Common Cuckoo (*Cuculus canorus*), British, presented by Mr. K. P. Spalding; two Javan Sparrows (*Padda oryzivora*) from Java, presented by Miss Coleman; a Black-headed Gull (*Larus ridibundus*), European, presented by Mr. Humphries; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Miss Simpson; a Common Chameleon (*Chamaeleon vulgaris*) from North Africa, presented by Master Cecil Guy Pratt; a Robben Island Snake (*Coronella phocarum*) from Robben Island, South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Macaque Monkey (*Macacus cynomolgus*) from India, a Siamese Blue Pie (*Urocissa magnirostris*) from Siam, an American Black Snake (*Coluber guttatus*) from North America, a Smooth-toothed Capuchin (*Cebus monachus*), a Squirrel Monkey (*Chrysothrix sciurea*) from South America, deposited; two Axolotls (*Siredon mexicanus*) from Mexico, purchased; fourteen Striped Snakes (*Tropidonotus sirtalis*), born in the Menagerie.

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, SEPTEMBER 6-12

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on September 6*

Sun rises, 5h. 22m.; souths, 11h. 58m. 8[illegible]s.; sets, 18h. [illegible]m.; decl. on meridian, 6° 18′ N.: Sidereal Time at Sunset, 17h. 38m.

Moon (New on September 8) rises, 2h. 11m.; souths, 9h. [illegible]m.; sets, 17h. 6m.; decl. on meridian, 14° 5′ N.

| Planet | Rises h. m. | | Souths h. m. | | Sets h. m. | | Decl. on meridian ° ′ |
|---|---|---|---|---|---|---|---|
| Mercury | 4 51 | ... | 11 28 | ... | 18 5 | ... | 6 14 N. |
| Venus | 8 29 | ... | 14 0 | ... | 19 31 | ... | 6 25 S. |
| Mars | 0 52 | ... | 8 40 | ... | 16 46 | ... | 22 14 N. |
| Jupiter | 5 30 | ... | 12 6 | ... | 18 43 | ... | 6 31 N. |
| Saturn | 23 18* | ... | 7 27 | ... | 15 35 | ... | 22 07 N. |

* Indicates that the rising is that of the preceding day.

| Sept. | h. | | |
|---|---|---|---|
| 8 | 4 | ... | Mercury in conjunction with and 0° 5′ south of the Moon. |
| 8 | — | | Total eclipse of Sun, visible only in regions near the south pole. |
| 8 | 22 | ... | Jupiter in conjunction with Sun; also in conjunction with and 1° 57′ north of the Moon. |
| 11 | 9 | ... | Mercury stationary. |
| 11 | 10 | ... | Venus in conjunction with and 6° 27′ south of the Moon. |

## GEOGRAPHICAL NOTES

MR. GARDNER, British Consul at Newchwang, publishes with his annual trade report this year (China, No. 6, 1885) a most interesting account of his consular district, which embraces the whole of Manchuria. It contains an area of about 300,000 square miles, and a population estimated by the Roman Catholic missionaries at 15,000,000. Its boundaries are, on the north, the Amur, separating it from Eastern Siberia; on the east the Ussuri River and Sihoti Mountains, separating it from the Russian province of Primorsk; on the south the Tumen and Yalu Rivers separating it from Corea, the Yellow Sea and the Gulf of Liao-tung; on the west China, Mongolia, and Russian Siberia. The first part of the report deals with the ordinary trade and productions of Manchuria, and gives a summary of the statistics of foreign trade since the port of Newchwang was opened to trade in 1861. The second part is devoted to geographical notes on Manchuria, its three provinces, Hei-lung Kiang or Saghalien, Kirin and Lingtung being taken separately. The history, government, military force, and divisions or towns are the heads under which these provinces are described. Various appendices contain an account of a journey from Moukden to San-sing, an essay on Christian missions in Manchuria, and a sketch of the botany of South Manchuria by Dr. Morrison. The latter is, from a scientific point of view, the most important part of the report. The list given is defective, as the greater part of Dr. Morrison's collections remain unidentified, there having been no opportunity of visiting herbaria or consulting published accounts of Northern Chinese plants.

THE report of the Resident in the State of Selangor in the Malay peninsula for the past year contains some curious information with regard to "aboriginal tribes" called the Sakais, who number between 700 and 800. They are in nine divisions under head-men called Batins, and they live mainly by collecting gutta, rattans, and other jungle produce. As far as is known they have no form of religious worship, but they are very superstitious, believing in good and bad omens, the sacred character of certain birds, and they always desert a village or unlucky on the death of any member of the tribe. They tattoo figures on their arms, but apparently only for the sake of ornament, and

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in constructive engineering can be overcome which would otherwise have been most formidable.

Mr. William Jones read a paper on processes for the recovery of tar and ammonia from blast furnaces fed with raw coal. [illegible]

[illegible]

## THE FORTH BRIDGE

[illegible]

under construction, but borings 200 feet in depth showed nothing but soft silt and mud, and the bridge, which was to have been two miles in length, inclusive of four spans of 500 feet each, was luckily abandoned, as the difficulties with the foundations would have proved practically insuperable. [illegible] Forth at Queensferry. At low water the width of the channel [illegible] and the island of Inchgarvie [illegible] Sir Thomas Bouch [illegible] fall of the Tay Bridge, public confidence in Sir Thomas Bouch's design was shaken, [illegible] the Forth Bridge was proceeded with. [illegible] North British, Great Northern, North-Eastern, and Midland Railway [illegible] prepared by Mr. Fowler and [illegible] Mr. Harrison and Mr. Barlow, [illegible] Parliamentary powers were obtained, and in January 1883 the works were commenced by Messrs. Tancred, Arrol, and Co., the contractors.

The total length of [illegible]

[illegible]

to compression without injuring its resistance to tension, or its ductility, which remained unaffected by previous compression in my experiments. At least one-half of the 42,000 tons of steel in the Forth Bridge is in compression, and the same proportion holds good in most bridges, so the importance of gaining an increased resistance of 60 per cent. without any sacrifice in the facility of working, and safety belonging to a highly ductile material, can hardly be exaggerated.

Our experience has led us to the conclusion that sheared edges are a more fruitful source of fracture than partial tempering or other contingencies. All of our best plates are made red-hot, and the effect of the shearing is thus eliminated even before planing. Those plates which are not heated have the edges carefully planed so as to leave no trace of the shearing, and we find that, whether we are dealing with 30-ton or 37-ton steel, the plates so treated stand all the [illegible] tests. Experiments which I have made, and am still making, on the resisting power of different classes of iron and steel to repeated bendings, such as the shaft of a marine engine undergoes if the bearings get out of line, indicate that the superiority of low tension steel is considerably greater than the increased ductility would indicate.

In conclusion I may state that the approximate value of the plant, &c., at the Forth Bridge is 250,000*l*., and of the work executed 100,000*l*.

## SOCIETIES AND ACADEMIES

SYDNEY

**Royal Society of New South Wales**, June 3.—Prof. Liversidge, F.R.S., President, in the chair.—A paper was read by Mr. G. H. Knibbs on a system of accurate measurement by means of long steel ribands. The chief feature of the method of measurement is the application of such tensions to the ribands as eliminate the effects of the suspension when it becomes necessary.—Mr. Law. Hargrave read a paper, notes on flying-machines, which consisted of deductions drawn from close observation of the behaviour of about fifty self-supporting flying-machines of various weights, from three quarters of an ounce to four ounces. Sixteen models were exhibited. Mr. Hargrave stated that, although he believed the trochoided plane to be the true mechanical power used by birds in flight, he thought its rejection as a scientific truth of very trifling importance compared with the patient variation and adjustment of the details of the models, so that rules could be laid down for work on a larger scale.

July 1.—Prof. Liversidge, F.R.S., President, in the chair.—A paper was read by Mr. H. C. Russell, B.A., on local variations and vibrations of the earth's surface.

PARIS

**Academy of Sciences**, August 24.—M. Bouley, President, in the chair.—Note on human locomotion; mechanism of the jump, [illegible] by MM. Marey and G. Demeny. The first communication on the [illegible] of human locomotion began with the act of springing or jumping, because, although not the most usual, it is regarded by the authors as by far the simplest, and much less [illegible] than walking or running, in which the body executes complicated movements in the direction of the three dimensions of space. The paper is illustrated by a chrono-photograph showing the successive positions of legs, arms, and shoulders [illegible] taking a standing leap [illegible] *pieds joints*; also by diagrams of [illegible] high jumps executed in the dynamograph.—Observations on the prevalence and development of pestilence and cholera in Persia, where quarantine preventive measures have never been adopted, by M. J. D. Tholozan. The author, who has had twenty-eight years' experience of the action of these epidemics in Persia, is inclined to think that the quarantine system would have proved of little or no avail in arresting their progress. The paper was followed by a few remarks by M. Larrey, also pointing at the general inefficacy of quarantine measures.—Note on M. Hirn's paper on the crepuscular lights inserted in the *Bulletin* of the Colmar Natural History Society, by M. Faye. From his observatory at Colmar the author noticed this phenomenon at an altitude far higher than that of the terrestrial atmosphere. Without deciding on the merits of the different theories advanced to explain its origin, he considers that electricity alone would be capable of retaining at such an altitude the particles of matter causing the afterglow, whether these particles were derived from the Krakatoa eruption or from the interstellar spaces.—Observations of the new planet, 249 (discovered by M. Peters on August 16 at Clinton, New York), made at the Paris Observatory (equatorial of the West Tower), by M. G. Bigourdan.—Observations of Barnard's comet made at the Observatory of Bordeaux with the 14-inch equatorial, by M. G. Rayet.—On the theory of revolving mirrors as a means of measuring the velocity of light, by M. Gouy.—Experiments on double refraction (four illustrations), by M. D. S. Stroumbo. By a simple contrivance the author renders visible to a large audience the course of two rays, ordinary and extraordinary, in a birefringent crystal: (1) when the two facets are artificial and perpendicular to the axis; (2) when they are artificial and parallel to the axis; (3) when they are the natural facets of the crystal parallel to each other.—Note on the alcoholic derivatives of pilocarpine, by M. Chastaing.—On the transmission of pathogenetic microbes from the mother to the foetus and to the milk, by M. Koubassoff. From experiments made on the guinea-pig the author infers that the charbon [illegible] the bacilli of tubercular affections, and other germs of disease pass into the milk and remain there during the term of lactation, or till the death of the mother; also that the fœtus nourished on such milk do not catch the respective diseases, but survive even the death of the mother; lastly, that the transmission of microbes from mother to foetus depends probably on the existence in the placenta of direct communications between the vessels of mother and fœtus.—On an alkaloid substance extracted from the liquid in which Koch's microbe was cultivated, by M. A. Gabriel Pouchet. An analysis of this liquid reveals traces of the presence of an alkaloid liquid presenting certain characteristics, such as smell and toxic properties, apparently identical with those detected in the dejecta of cholera patients. Should these results be definitely established, they would furnish an indirect proof that Koch's microbe is really the pathogenic agent in cholera.—Influence of the sun on the vegetation of the spores of *Bacillus anthracis*, by M. S. Arloing.—Action of the [illegible] on the higher organisms: iodine, nitrate of silver, [illegible] by MM. Mairet, Pilatte, and Combemale.—A note was received from M. Sacc of Cochabamba, on an extremely rich deposit of alunite lately discovered in the Peruvian Andes.

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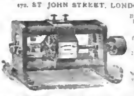

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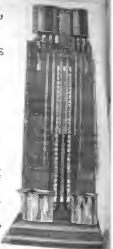

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# NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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

No. 828, Vol. 32] THURSDAY, SEPTEMBER 10, 1885 [PRICE SIXPENCE

THURSDAY, SEPTEMBER 10, 1885

## *OUR PRESENT NEEDS*

IF it be fair to forecast the success of a meeting of the British Association by the quality of the addresses delivered by the various presidents, then we may predict that the meeting of this year at Aberdeen, which began yesterday, will stand out among its fellows. We think it would be hard to find any prior occasion on which such a high standard of excellence had been reached all round.

The growing use as well as the growing feeling for the need of scientific methods comes out in a most noticeable way; while there is no fear that either hearers or readers will be lulled into a Sleepy Hollow of satisfaction or a restful be-thankful feeling. For that much remains to be done even in the way of initial organisation both of teaching and working, is frankly and fearlessly acknowledged by several of the speakers.

These present needs may well occupy our attention, and we may begin by those pointed out by the President of the Association himself, who speaks both as a man of Science and a politician. No one knows better than Sir Lyon Playfair how Science can aid the body politic, or knows better how each party when in office neglects or uses this powerful engine for the nation's good. He begins by quoting these noble words from the address of the President at the Aberdeen Meeting in 1859, the lamented Prince Consort: "We may be justified in hoping [illegible] that the Legislature and the State will more and more recognise the claims of Science to their attention, so that it may no longer require the begging box, but speak to the State like a favoured child to its parent, sure of his paternal solicitude for its welfare; that the State will recognise in Science one of its elements of strength and prosperity, to foster which the clearest dictates of self-interest demand."

One can get no better idea of the [illegible] condition of the Government and of the House of Commons in matters of science than from the fact that much of what follows in the President's Address has not been said in the House itself instead of at Aberdeen. The real reason perhaps is to be gathered from a remark made by Prof. Chrystal in his address in Section A:—

"We all have a great respect for the integrity of our British legislators, whatever doubts may haunt us occasionally as to their capacity in practical affairs. The ignorance of many of them regarding some of the most elementary facts that bear on every day life is very surprising. Scientifically speaking, uneducated themselves, they seem to think that they will catch the echo of a fact or the solution of an arithmetical problem by putting their ears to the sounding shell of uneducated public opinion. When I observe the process which many such people employ for arriving at what they consider truth, I often think of a story I once heard of an eccentric German student of chemistry. This gentleman was idle, but, like all his nation, systematic. When he had a precipitate to weigh, instead of resorting to his balance, he would go the round of the laboratory, hold up the test tube before each of his fellow students in turn, and ask him to guess the weight. He set down all the replies, took the average, and entered the result in his analyses."

Now if this view of our legislators is shared by men of such eminence as Sir Lyon Playfair and others in the House of Commons more or less connected with science, we can well understand their silence in the [illegible] of the nation which so little resembles the Witenagemote of former times.

In his pleading for more State recognition of science the President points to the present activity of Germany and France, and especially of the United States:—

"Both France and Germany make energetic efforts to advance Science with the aid of their national resources. More remarkable is it to see a young nation like the United States reserving 150,000,000 acres of national lands for the promotion of scientific education. In some respects this young country is in advance of all European nations in using Science in its administrative offices. Its scientific publications, like the great palæontological work embodying the researches of Prof. Marsh and his associates in the Geological Survey, are an example to other Governments. The Minister of Agriculture is surrounded with a staff of botanists and chemists. The Home Secretary is aided by a special Scientific Commission to investigate the habits, migrations, and food of fishes, and the latter has at its disposal two specially constructed steamers of large tonnage. The United States and Great Britain promote fisheries on different systems. In this country we are perpetually issuing expensive Commissions to visit the coasts in order to ascertain the experiences of fishermen. I have acted as Chairman of one of these Royal Commissions, and found that the fishermen, having only a knowledge of a small area, gave the most contradictory and unsatisfactory evidence. In America the questions are put to Nature, and not to fishermen. Exact and searching investigations are made into the life history of the fishes, into the temperature of the sea in which they live and spawn, into the nature of their food, and into the habits of their natural enemies. For this purpose the Government give the cooperation of the Navy, and provide the Commission with a special corps of skilled naturalists, some of whom go out with the steamships, and others work in the biological laboratories at Wood's Hall, Massachusetts, or at Washington. The practical results flowing from these scientific investigations have been important. The inland waters and rivers have been stocked with fish of the best and most suitable kinds. Even the great ocean which washes the coasts of the United States is beginning to be affected by the knowledge thus acquired, and a sensible result is already produced upon the [illegible] importance of its fisheries. The United Kingdom largely depends upon its fisheries, but as yet our own Government have scarcely realised the value of such scientific investigations as those pursued with success by the United States."

He quotes with approval a passage from Washington's farewell to his countrymen: "Promote as an object of primary importance institutions for the general diffusion of knowledge. In proportion as the structure of a Government gives force to public opinion it is essential that public opinion should be enlightened." He next points out that it was not till 1870 that England established a system of education at all, and that now, while all great countries, except our own, have Ministers of Education, we have only Ministers who are managers of primary schools.

Passing on to the State need of abstract knowledge, we read as follows:—

"Ali, the son-in-law of Mahomet, the fourth successor to the Caliphate, urged upon his followers that men of science and their disciples give security to human progress. Ali loved to say, 'Eminence in science is the highest of honours;' and 'He does not die who gives life to learning.' In addressing you upon texts such as these my purpose was to show how unwise it is for England to lag in the onward march of science when most other European Powers are using the resources of their States to promote higher education and to advance the boundaries of knowledge. English Governments alone fail to grasp the fact that the competition of the world has become a competition in intellect."

We have seen how Sir Lyon Playfair twits the heads of the Education Department with being merely managers of primary schools. The President of the Chemical Section, Prof. Armstrong, also shows reason why their functions must be expanded if science is ever to get on here. He holds that without State [illegible] the [illegible] which at present prevent the [illegible] teaching institutions from exercising their [illegible] of influence upon the advancement of our national prosperity [illegible] superable. He foresees the objection that [illegible] interference would deprive teaching centres [illegible] individuality, but he denies that this must necessarily follow, and we know no one who has a better right to express an opinion on such a subject.

Some part indeed of Prof. Armstrong's address is terrible reading. The present chemical education and chemical examinations in this country are, according to him, to a large extent shams, and worse. The students who come to the centres of higher instruction are [illegible] reasoning beings: they have never been taught to reason; and at these centres the instruction has been of too technical a character, while hardly anywhere is there an atmosphere of research. We commend this part of Prof. Armstrong's address strongly to our readers. He points out, among many other matters, the vital importance of the research atmosphere, and he frankly states the difficulties left by [illegible] [illegible]. On this point, indeed, we think him a little too sensitive. Many of the remarks so often made now touching the absence of research in our chemical laboratories apply not to such men as him, but to those whose training, spirit, and proclivities are well known: men who dishonour the profession to which they belong. Still, it is well that the difficulties should be fairly recorded, especially in juxtaposition with a statement that absence of research must always indicate the absence of teaching worthy of the name.

A complete revision of the present system, both of teaching and examining in chemistry, is, therefore, according to Prof. Armstrong, one of the most pressing of our present needs.

Are the other sciences better off? Certainly not mathematics if Prof. Chrystal has a right to speak for that branch:—

"All men practically engaged in teaching who have learned enough, in spite of the defects of their own training, to enable them to take a broad view of the matter, are agreed as to the canker which eats [illegible] thing that is good in our educational practice [illegible] is the absurd prominence of written competitive examinations that works all that mischief."

But some may think that in the setting of problems mathematics teachers have an advantage over others in preventing unintelligent cramming. This is not Prof. Chrystal's opinion:—

"The history of this matter of problems, as they are called, illustrates in a singularly instructive way the weak point of our English system of education. They originated, I fancy, in the Cambridge Mathematical Tripos Examination, as a reaction against the abuses of cramming bookwork, and they have spread into almost every branch of science teaching—witness test-tubing in chemistry. At first they may have been a good thing; at all events the tradition at Cambridge was strong in my day, that the man that could work the most problems in three or two and a half hours was the ablest man, and, be he ever so ignorant of his subject in its width and breadth, could afford to despise those less gifted with this particular kind of superficial sharpness. But, in the end, came all to the same: we were prepared for problem-working in much the same way as for bookwork. We were forced to work through old problem papers, and study the [illegible] and peculiarities of the day and of the examiner. The day and the examiner had, in truth, much to do with it, and fashion reigned in problems as in everything else. The only difference I could ever see between problems and bookwork was the greater predominance of the [illegible] element of luck in the former. This advantage was more than compensated for by the peculiarly [illegible] and, from a truly scientific point of view, [illegible] nature of the training which was employed to [illegible] this species of mental athletics. The result, as far as problems worked in examinations go, is, after all, [illegible] [illegible] in the reiterated complaints of examiners [illegible] the effect on the examinee is a well-known [illegible] vation of mind, an almost incurable superficiality, what might be called Problematic Paralysis—a disease which unfits a man to follow an argument extending beyond the length of a printed octavo page."

As to the crying present need, Prof. Chrystal and Armstrong are at one. We want a higher ideal of education in general and of scientific education in particular.

"Science cannot live among the people, and scientific education cannot be more than a words rehearsal of dead text books, unless we have living contact with the working minds of living men. It takes the hand of God to make a great mind, but contact with a great mind will make a little mind greater. The most valuable instruction in any art or science is to sit at the feet of a master, and the next best to have contact with another who has himself been so instructed. No agency that I have ever seen at work can compare for efficiency with an intelligent teacher, who has thoroughly made his subject his own. It is by providing such, and not by sowing the dragon's teeth of examinations, that we can hope to raise up an intelligent generation of scientifically educated men, who shall help our race to keep its place in the struggle nations. In the future we must look more to men and to ideas and trust less to mere systems. Systems have had their trial. In particular, systems of examination have been tested and found wanting in nearly every civilised country on the face of the earth."

What we have written will show what food for thought in the matter of our present needs has been provided at Aberdeen for those gathered together for the advancement of science. Seen [illegible] the three addresses to which we have [illegible] referred in the present article suggest a gap in the [illegible] of the Association. Why should there not be a [illegible] to deal specially with the question of Education and Research?

## THE DECOMPOSITION OF DIDYMIUM

UNTIL [illegible] be [illegible] recently [illegible] reprinted from the [illegible] *Zeitung* a notice of an important piece of work recently communicated to the Vienna Academy by Dr. [illegible] von Welsbach. The work appears to have resulted in the discovery that the "element" [illegible] "atomic weight" [illegible] [illegible] Sorby explored, and which [illegible] separated by Mosander in 1841 has been [illegible] by Marignac, Hermann, Watts, Bunsen, Hevelius and Lecoq de Boisbaudran, many others [illegible] element [illegible] substances which can [illegible] ordinary chemical processes. This "decomposition" was in fact effected by means of the [illegible] of sodium nitrate in presence of [illegible]

The [illegible] of the two substances are quite [illegible] The [illegible] and [illegible] characteristics [illegible] those of the [illegible] and [illegible] greatest [illegible] Dr. [illegible] Welsbach proposes for these two [illegible] the names of "praseodymium" and "neodymium."

[illegible] from the chemical point of view [illegible] of very high interest, but [illegible] from which they assume a very great importance.

The "element" didymium after it was separated by the chemists has been handed over to the physicists. [illegible] we believe, was among the first to note the characteristic absorption spectrum of the salts. In this work he was followed by [illegible] and Bunsen, [illegible] and others. They also determined its spark spectrum, and in our spectroscopic literature didymium has taken its place [illegible] of hydrogen and iron as a characteristic [illegible] element.

Now one of the arguments which has been used in support of the view put forward some time ago of the [illegible] of the chemical elements at solar temperatures [illegible] that at one "heat level" in the sun's atmosphere [illegible] because the sun's atmosphere must get hotter as we go down, and we have means of determining which vapours ascend from hotter regions and which descend from cooler ones, we get some lines of the spectrum of a substance, let us say iron, and at another we get others, so that to get the complete spectrum of iron, as we see it when we use iron in our laboratories, we have to add together the two sets of lines seen in the spectra of parts of the sun known to be at different temperatures.

To make our statements more precise we may say that the lines of iron seen bright in the spectra of solar prominences and those seen widened in the spectra of solar spots are so different that it may be said that there is hardly a line common to both. So much so that, as [illegible] years ago, if we did not know iron here, and the fact that its spectrum contains both sets of lines, we should say that the prominences had iron contained one substance and the spots had iron contained another.

These facts were explained by the hypothesis that there were in the so-called element iron at least two different substances or molecular groupings, one of which alone could withstand the higher temperature of the prominences. The reason that both sets of lines and many others are seen in the spectrum of iron in the high-tension spark is that the temperature of the spark is sufficient to carry the solid metal through the series of [illegible] whether many or few, which lie between the lines formed in the solid state and the temperature of the prominences.

To this it has been objected that if these things exist in iron they should be isolated and put in bottles. To this it has been replied that the bottles themselves must be [illegible] of the [illegible] things will unite again as they [illegible] before to form iron as we know it.

Now the real importance of Dr. von Welsbach's work is that what has not yet been done for iron—to prove beyond all cavil the above hypothesis—he has done for didymium. He has got into two bottles, which we may [illegible] label "spot bottle," "prominence bottle," two substances from the "element" didymium, each of which has a characteristic spectrum consisting of different parts of the spectrum of didymium [illegible] the spots and prominences [illegible] which are different parts of the spectrum of iron. Further, by mixing the substances in these two bottles together in proper proportions he can produce a third, which gives the mapped spectrum of didymium [illegible] the general spectrum of the sun in which we get, added together, the absorptions of the hotter and cooler regions represented by prominences and spots, we have got iron, something not unlike the arc spectrum of that substance.

There is no doubt that the interest of both chemists and physicists will be keenly excited by Von Welsbach's work, and that it will be critically examined and repeated. If it be confirmed we may hope that some day similar work will be undertaken here. The way is open and has been cleared in a remarkable way. Formerly it was imagined that very high temperatures and new chemical methods were the sole agents to which appeal could be made in such a case: it may turn out that there are reagents to hand if chemists will turn their attention to them.

It is further clear that the "elements" with high atomic weight should be the first to be attacked. Those who consider the spectrum of cerium, for instance, which in the blue and violet portion is richer in lines than the spectrum of the sun itself, to be produced by the vibration of "the chemical atom" or "the chemical molecule," no matter which, will find themselves in a hopeless minority, now that the simpler explanation of a mixed origin has apparently received confirmation in the case of another substance.

But although we have chiefly confined ourselves to the spectroscopic bearing of the work, it is not too much to say of it that, if this separation be in the sense as indicated, it is the most important work in mineral chemistry we have had for many years. By patient work the group of cerium, didymium, &c., metals has yielded several new metallic oxides, differing considerably from didymium, but having the same general reactions, being members of the same group in fact. The difference in the ordinary chemical reactions of cerium, lanthanum, didymium, scandium, terbium, ytterbium, and probably samarium is generally very slight, and they can only be separated by long-continued operations, nearly always cases of fractional separation. The close relationship of these metallic oxides has been long recognised, and the group has been considered peculiar in this respect, and in consequence an immense amount of labour has been expended upon it, more than has ever been expended on groups of other metallic oxides. Indeed, the notion that heat is the agent of chemical resolution seems to have gained such a hold that apparently for the last two, or three, decades, with the exception of the cerite metals, it is the only reagent the action of which has been taken as definitive in establishing a thing to be an element. We are not aware that any records of patient work on chromium exist, attempts to isolate any other substance from chromium oxide other than our ordinary chromium. The general properties of this, or these, oxides surely invite to further investigation. And in the case of nickel and cobalt, which appear almost to be isomers, there is a fine field for investigation which might be as profitably cultivated perhaps as an almost infinite series of carbon compounds.

## OUR BOOK SHELF

***Annuaire géologique univ... et Guide du Géologie autour de la Terre.*** Par le Dr. Dagincourt. (Paris: Comptoir géologique de Paris, 1885.)

THIS is the first annual issue of a geological guide edited by the Secretary to the Geological Society of France, which cannot fail to be of the greatest use as a book of reference to those concerned with geology all over the world. *Multum in parvo* would be a very suitable motto for the book, for the amount of information which it contains in a small space is really marvellous. The editor does not profess to have carried out the whole of the programme which he has set before himself in the present issue; but it was decided to bring out the volume this year on account of the meeting of the Geological Congress at Berlin, and also in order that he may be able in the ensuing issue to profit by private and public criticism. The best criticism of it will be a bare statement of its contents. It first describes the history, various meetings and utility of the Congress of Geologists, with the proceedings at the meetings in Paris and Bologna. It then takes the continents in alphabetical order, and the countries in them in the same way, and supplies a mass of geological information of all kinds with regard to each. Taking as an example the first country under the head Europe, which is Germany (Allemagne), we find a list of books on the bibliography of German geology, of general (as distinguished from special and detailed) geological maps, [illegible] of the leading works on certain districts; these are [illegible]ceded by a general sketch of the geological features [illegible]Germany, and of the occurrence of the various geological systems; then a detailed account of the organisation for the production of geological maps in the various countries and provinces composing the German Empire; then a sketch of the institutions in which geology is taught, the various universities with their professors, laboratories, collections, museums, &c., the professors at the various polytechnic and agronomical schools, the public and private geological collections, with in some cases, brief descriptions of the principal features (these occupy a considerable space), then the various geological societies, with their organisations; next the periodical publications, their prices, size, general nature of the contents, divided into five classes—(1) those specially geological, (2) those containing from time to time geological papers, (3) geographical periodicals containing geological papers, (4) those devoted to mining, (5) collections of geological and palæontological memoirs. These lists are succeeded by others which form a very important feature of the work—viz. the names, addresses, and special fields of all the geologists in the German empire; and finally the titles of all the books and papers which have appeared during the past year on mineralogy, petrography, geology, and palæontology, arranged in alphabetical order. This description of the volume under the head "Allemagne," will give an accurate idea of the scope and arrangement of the book, for although circumstances have prevented the scheme being carried out with the same degree of thoroughness for every part of the globe, the volume will year by year approach nearer to, doubtless even improve upon, this standard. In the case of Great Britain, for instance, the issue for 1886 will contain a thorough study of our geology, and its teaching in our universities and other public institutions. Its ultimate completeness must naturally depend much on the assistance which the editor receives from geologists all over the world in supplying information, making the necessary alterations required by time, offering suggestions and adding corrections; and the volume is so useful and full in design that we have little doubt Dr. Dagincourt's fellow-geologists will willingly help him to carry it out in all its details. We observe that Tasmania has by an error been put amongst Asiatic countries instead of in Australasia.

## 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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### The Meteoric Cycle and Stonehenge

WE are now passing through the hundredth meteoric cycle of nineteen years, which commenced with A.D. 1882, and will terminate with A.D. 1900. These cycles began with the year of our Saviour's birth, and our prayer books contain tables showing for many successive years on what days Easter days and our movable festivals will occur. At the end of every such cycle the new and full moons happen within an hour and a half of the same time of the year as they did at the beginning.

With these cycles is commonly associated the name of Meton, an astronomer of Athens, who wrote a book on the subject, by which the Greeks regulated the recurrence of their festivals. He flourished 432 years B.C. But the knowledge of these cycles existed in England centuries before the time of Meton, as I will presently show, and it is probable that the four very ancient erections supposed to have been temples of the sun near Penzance, had reference to this cycle of nineteen years, as they each consisted originally of nineteen stones placed upright and rising from 3 to 6 feet above the ground in rude circles varying in diameter from 65 to 80 feet. These temples are still existing, although some of their stones have fallen, and they are miles from each other, but are all called in the printed maps, as well as immemorially, by one and the same name, viz. "Nine

*Maidens*," which is simply an abbreviation for *Nineteen Maidens*.

The following quotation from Diodorus Siculus (Book II. chap. iii. Booth's Trans., page 139), who flourished about forty-four years B.C., will be an historical confirmation of what I have above stated :—

"Amongst those who have written old stories much like fables, Hecatæus (born 549 years B.C.) and some others say that there is an island in the ocean over against Gaul (as big as Sicily) under the Arctic pole, where the Hyperboreans inhabit, so called because they lie beyond the breezes of the north wind ; that the soil there is very rich and fruitful, and the climate temperate, inasmuch as there are two crops in the year."

This description does not apply to the whole of the island referred to, but represents Mount's Bay, its most south-western extremity, and we may therefore conclude that those from whom Hecatæus and the others derived their information were the Phœnician traders who for centuries previously frequented Mount's Bay for tin and fish, and who imagined all Britain to possess the same rich soil and mild climate as Mount's Bay where still "there are two crops in the year." But to proceed with the quotation :—

"They say that Latona was born there, that they worship Apollo above all other gods, and the inhabitants demean themselves as if they were Apollo's priests, who has there a stately grove and a renowned temple of a round form, and that there is a city likewise consecrated to this god. The sovereignty of this city and the care of the temple (they say) belong to the Boreades."

This city and this "renowned temple of a round form" are doubtless those of Old Sarum and Stonehenge, the inner oval of which, immediately around the altar, consists of precisely nineteen stones (see the plate in Dr. Stukeley's "Stonehenge," page 20). But the four temples of the sun above described of nineteen stones each, placed upright "in a round form" to represent the cycle of nineteen years, are not mentioned by Diodorus, as they were probably deemed not worthy of notice after alluding to the renowned temple of Stonehenge. The passage concludes as follows :—

"They say, moreover, that Apollo once in nineteen years comes into the island, in which space of time the stars perform their courses, and return to the same point, and therefore the Greeks call the revolution of nineteen years 'the great year.'"

Plymouth, August R. EDMONDS

### Nebula in Andromeda

LAST night the nebula in Andromeda was observed here. The stellar-like nucleus was distinctly seen. It appeared to be of a reddish-yellow colour as contrasted with that of the nebula. We think that a change has certainly taken place, no such stellar-like centre having previously been seen in the nucleus. The stellar point was examined with a small prism held between the eye-piece and the eye. A continuous spectrum was seen. Dr. Boeddicher and I were both convinced that there were considerable inequalities in its light, and independently formed the impression that there was at times a bright band or line in the green. The colour of the stellar point appeared much the same as that of Aldebaran. ROSSE

Observatory, Birr Castle, September 8

### Sunsets

IN July of this year I spent a short time in the Schwarzwald of Baden. For more than a week the sky was cloudless day and night, yet the heat was not oppressive. The sunsets were beautiful beyond description, and the after-glows magnificent. One evening in particular will always remain impressed upon my memory. It was that of July 26, and the place was a few miles from the town of Neustadt, nearly in the centre of the forest. Wonderful effects began to appear so soon as the sun touched the crest of the western hills. But these were as nothing compared with what followed. The moment the luminary had disappeared behind the hills long streamers began to radiate high up into the heavens, and for a time, as the daylight diminished, they increased both in length and intensity, rivalling any description or figures of the Arctic auroras that I have ever seen ; at the same time the most vivid and ever-changing glow lit up the whole western heavens. The scene lasted more than an hour, and its effect was heightened by, and perhaps partly due to, a nearly full moon, which rose from behind a slight dip or pass in the hills on the eastern side of the valley. The inhabitants of the Schwarzwald are indubitably phlegmatic, and not easily moved to excitement ; but this display of celestial pyrotechnics was too much for them, and at a small roadside inn the carters and others who were enjoying their beer inside turned out *en masse* to witness it. I am not a strong admirer of Turner's pictures, but, in comparing nature with art, one idea came uppermost—the scene was "Turneresque."

Lewisham, S.E., September 3 R. MCLACHLAN

### Pulsation in the Veins

MR. HIPPISLEY will find a very simple way of showing pulsation in the veins, as well as in the arteries, by fixing a long bristle or thread of sealing-wax over the vessel by means of a little tallow. The end of the lever will vibrate and produce all the movements of the sphygmograph. This method was adopted by Mr. Wilkinson King nearly fifty years ago, and the instrument styled by him the sphygmometer. In his paper in the Guy's Hospital Reports for 1837, "On the Safety Valve Function of the Right Ventricle of the Heart," will be found much valuable matter and discussion about venous pulsation.

August 29 S. W.

### Red Hail

VU l'intérêt que peut offrir la coloration de la grêle, j'espère que vous voudrez bien insérer ces quelques lignes dans votre journal : "La grêle colorée en rouge, observée par Mr. Mullan et dont il est question dans le No. 812 de ce journal, n'est pas un fait isolé. On a observé un cas analogue en 1880, le $\frac{2}{14}$ juin, en Russie. Les grêlons de cette chute-là étaient intéressants sous plus d'un rapport. Leur forme se ramenait à trois types : parallélipipède, cylindre, sphéroïde très-aplati et muni de cavité aux bouts de la petite axe. Certains de ces grêlons étaient percés de part en part, le long de la petite axe, ce qui leur donnait l'apparence des anneaux. Certains des grêlons étaient colorés en rouge-pâle, d'autres avaient la couleur bleu-pâle, mais pour la plupart les grêlons étaient gris ou blanc. L'observateur, M. Lagounowitch, crut avoir remarqué que la couleur était liée à la forme des grêlons. Je cite ces faits et j'en propose l'explication dans ma brochure, 'Sur l'Origine de la Grêle.'"

THÉODORE SCHWEDOFF,
Professeur de Physique à l'Université d'Odessa

Odessa, le $\frac{15}{27}$ août, 1885

### On the Terminology of the Mathematical Theory of Electricity

MR. SUTHERLAND'S letter on terminology (NATURE, vol. xxxii. p. 391) leads me to suggest to Mr. Scott the employment of the term *low-pression* for depression in his weather forecasts sent to the newspapers. It is nearly as easily pronounced and written, and will not have such a tendency to mislead the general public as to there being a depressing of the air where it really ascends. HENRY MUIRHEAD

Cambuslang

## THE BRITISH ASSOCIATION

*Aberdeen, Monday*

THIS place has evidently been astir for days in anticipation of the present meeting. Already are the directions necessary for visitors finding their way to the various sections put up in conspicuous places in Union Street and the neighbourhood of Marischal College. The accommodation in the fine building for reception rooms, committee rooms, reading, sectional, and other rooms, seems, so far as can be judged at present, everything that could be desired. It is evident that the Local Committee have been working in earnest to make the second Aberdeen meeting a success, and their efforts have been heartily supported by the citizens and country people. Up to Saturday 1000*l*. worth of tickets had been sold to local people alone, and many more will be sold between this and Wednesday. Of old members of the Associat[illegible] 750 have already written that they intend to be pr[illegible] and it is confidently anticipated that quite 2500 people will take out tickets for the meeting. This great influx of strangers has tasked the available accommodation in Aberdeen, and, as might be expected, the charges in hotels and lodging houses are somewhat exorbitant.

Of foreigners who are to be present one of the most distinguished is Prof. O. C. Marsh, the well-known American palæontologist, who, it is expected, will take part in the proceedings of Section [illegible] and [illegible]. Others are the Abbé Renard of Brussels, Dr. Max Schuster of Vienna, Dr. von Dechen of Bonn, and Prof. Radlkofer of Munich. It is expected that Mr. Im Thurn, the naturalist, who recently ascended Mount Roraima in British Guiana, will be able to be here, and tell personally of his ascent and its important results.

Of the excursions, that to Balmoral on Saturday is evidently the favourite, and there will be considerable competition to be included among the [illegible]. The Earl of Crawford has for the same day invited sixty members to [illegible] Dunecht, where the observatory will be inspected, and where the [illegible] will be shown the "[illegible] of Dunecht". The Earl of Crawford [illegible] contributed several very valuable and interesting objects [illegible] exhibition of antiquities, old books and manuscripts that is being arranged. Among the expeditions arranged for Thursday the 17th, is one specially for geologists, to Portsoy, and for the same day the Rev. W. Gordon invites a party of naturalists to Braemar.

Among the local establishments which will be open to the inspection of visitors [illegible] of the great granite works for which Aberdeen is so famous.

Another exhibition of special interest, arranged by the Scottish Geographical Society, will consist of Scottish maps, including some 150 different maps, atlases, guides, and special topographical works.

If one may judge from the present appearance of the weather, the meteorological conditions promise to be favourable, and, if so, the meeting will be sure to be successful, so far as pleasure [illegible] concerned, while the discussions that have been arranged by the Sections [illegible] and it are likely to [illegible] importance.

INAUGURAL ADDRESS OF THE RIGHT HON. SIR LYON PLAYFAIR, K.C.B., M.P., F.R.S., PRESIDENT

I. [illegible]

[illegible] Canada [illegible] great national life out of petty provincial existence in a time of profound peace. This [illegible] gave an immense impulse to her material resources. The Dominion still requires consolidation to its vast extent, and applied science is rapidly effecting it. Canada, with its great expanse of territory, nearly as large as the United States, is being knit together by the iron bands of railways from the Gulf of St. Lawrence to the Pacific Ocean, so that the fertile lands of Ontario, Manitoba, Columbia, and the North-Western territories will soon be available to the world. Still [illegible] has much to accomplish. England and France, with only one-fifth the fertile area of Canada, support 80 millions of people, while Canada has a population not exceeding 5 millions. A less far-seeing people than the Canadians might have ignored the applied science which they so much require. But they knew that without science there are no applications. They no doubt felt with Emerson:—

> And what if Trade sow cities
> Like shells along the shore,
> And thatch with towns the prairie broad
> With railways ironed o'er?
> They are but sailing foam-bells
> Along Thought's causing stream,
> And take their shape and sun-colour
> From him that sends the dream.

So it was with a far-reaching foresight that the Canadian Government invited the British Association for the Advancement of Science to meet in Montreal. The inhabitants of Canada received us with open arms, and the science of the Dominion and that of the United Kingdom were welded. We found in Canada, as we had every reason to expect, men of sturdy and self-reliant character, who loved not less than we did the old home from which they had come. Among them is the same [illegible] of political and moral life, with the same love of [illegible] which distinguishes the English people. Our great men are their great men; our Shakespeare, Milton, and Burns belong [illegible] as much as to ourselves; our Newton, Dalton, Faraday and Darwin are their men of science as much as they are ours. Thus a common possession and mutual sympathy made the meeting in Canada a successful effort to stimulate the progress of science, while it consolidated, at the same time, the principle that all people of British origin—and I would fain include our cousins in the United States—possess a common interest in the [illegible] of their race, and ought, in science at least, to [illegible] part and parcel of a common empire, whose heart is here in the small islands of the northern seas, but whose [illegible] in all her limbs, carrying warmth to them and bringing [illegible] vigour to [illegible]. Nothing can be more cheering to us [illegible] to know that many of the young communities of English-speaking people all over the globe—in India, China, Japan, the Straits, Ceylon, Australia, New Zealand, the Cape—have formed scientific societies in order to promote the growth of scientific research. No doubt science, which is only a [illegible] [illegible] in all lands, but still its unity of purpose and [illegible] received an important practical expression by our meeting [illegible]. This [illegible] of science will be continued by the act that we have invited Sir William Dawson, of Montreal, to be our next President at Birmingham.

II. *Science and the State.*—I cannot address you in Aberdeen without recalling that when we last met in this city our President was a [illegible] prince. The just verdict of time is that, [illegible] royal rank, he has a far nobler claim to our regard as a [illegible] of humanity in its widest sense, and especially as a lover of those arts and sciences which do so much to adorn [illegible]. In September 14, 1859, I sat on this platform and heard the [illegible] of the [illegible] and wise counsel of the Prince Consort [illegible] of his household, it was my privilege to [illegible] with this [illegible] prince in many questions relating to the advancement of science. I naturally, therefore, turned to the Presidential address to see whether I might not now [illegible] which he then gave with all the breadth [illegible] of his masterly speeches. I found it [illegible] for my own discourse in some pregnant remarks which he made upon the relation of science to the State. They [illegible]:—"We may be justified in hoping . . . that the Legislature and the State will more and more recognise the claims of science to their attention, so that it may no longer require the begging box, but speak to the State like a favoured child to its parent, sure of his paternal solicitude for its welfare; that the State will recognise in science one of its elements of strength and prosperity, to foster which the clearest dictates of self-interest demand."

This opinion, in its broadest sense, means that the relations of science to the State should be made more intimate because the advance of science is needful to the public weal.

The importance of promoting science as a duty of statecraft was well enough known to the ancients, especially to the Greeks and Arabs, but it ceased to be recognised in the dark ages, and was lost to sight during the revival of letters in the fifteenth and sixteenth centuries. Germany and France, which are now in such active competition in promoting science, have only publicly acknowledged its national importance in recent times. Even in the last century, though France had its Lavoisier and Germany its Leibnitz, their Governments did not know the value of science. When the former was condemned to death in the Reign of Terror, a petition was presented to the rulers that his life might be spared for a few weeks in order that he might complete some important experiments, but the reply was, "The Republic has no need of savants." Earlier in the century the much-praised Frederick William of Prussia shouted with a loud voice, during a graduation ceremony in the University of Frankfort, "An ounce of mother-wit is worth a ton of university wisdom." Both France and Germany are now ashamed of these utterances of their rulers, and make energetic efforts to advance science with the aid of their national resources. More remarkable is it to see a young nation like the United States reserving 150,000,000 acres of national lands for the promotion of scientific education. In some respects this young country is in advance of all European nations in joining science to its administrative offices. Its scientific publications, like the great palæontological work embodying the researches of Prof. Marsh and his associates in the Geological Survey, are an example to other Governments. The Minister of Agriculture is surrounded with a staff of botanists and chemists. The Home Secretary is aided by a special Scientific Commission to investigate the habits, migrations, and food of fishes, and the latter has at its disposal two specially-constructed steamers of large tonnage. The United States and Great Britain promote fisheries on distinct systems. In this country we are perpetually issuing expensive Commissions to visit the coasts in order to ascertain the experiences of fishermen. I have acted as chairman of one of these Royal Commissions, and found that the fishermen, having only a knowledge of a small area, gave the most contradictory and unsatisfactory evidence. In America the questions are put to Nature, and not to fishermen. Exact and searching investigations are made into the life-history of the fishes, into the temperature of the sea in which they live and spawn, into the nature of their food, and into the habits of their natural enemies. For this purpose the Government give the co-operation of the navy, and provide the Commission with a special corps of skilled naturalists, some of whom go out with the steamships and others work in the biological laboratories at Wood's Holl, Massachusetts, or at Washington. The different universities send their best naturalists to aid in these investigations, which are under the direction of Mr. Baird, of the Smithsonian Institution. The annual cost of the Federal Commission is about 40,000*l.*, while the separate States spend about 20,000*l.* in local efforts. The practical results flowing from these scientific investigations have been important. The inland waters and rivers have been stocked with fish of the best and most suitable kinds. Even the great ocean which washes the coasts of the United States is beginning to be affected by the knowledge thus acquired, and a sensible result is already produced upon the most important of its fisheries. The United Kingdom largely depends upon its fisheries, but as yet our own Government have scarcely realised the value of such scientific investigations as those pursued with success by the United States. Less systematically, but with great benefit to science, our own Government has used the surveying expeditions, and sometimes has equipped special expeditions to promote natural history and solar physics. Some of the latter, like the voyage of the *Challenger*, have added largely to the store of knowledge; while the former, though not primarily intended for scientific research, have had an indirect result of infinite value by becoming training-schools for such investigators as Edward Forbes, Darwin, Hooker, Huxley, Wyville Thomson, and others.

In the United Kingdom we are just beginning to understand the wisdom of Washington's farewell address to his countrymen when he said: "Promote as an object of primary importance institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened." It was only in 1870 that our Parliament established a system of national primary education. Secondary education is chaotic, and remains unconnected with the State, while the higher education of the universities is only brought at distant intervals under the view of the State. All great countries except England have Ministers of Education, but this country has only Ministers who are the managers of primary schools. We are inferior even to smaller countries in the absence of organised State supervision of education. Greece, Portugal, Egypt, and Japan have distinct Ministers of Education, and so also among our Colonies have Victoria and New Zealand. Gradually England is gathering materials for the establishment of an efficient Education Minister. The Department of Science and Art is doing excellent work in diffusing a taste for elementary science among the working classes. There are now about 78,000 persons who annually come under the influence of its science classes, while a small number of about 200, many of them teachers, receive thorough instruction in science at the excellent school in South Kensington, of which Prof. Huxley is the Dean. I do not dwell on the work of this Government department, because my object is chiefly to point out how it is that science lags in its progress in the United Kingdom owing to the deficient interest taken in it by the middle and upper classes. The working classes are being roused from their indifference. They show this by their selection of scientific men as candidates at the next election. Among these are Profs. Stuart, Roscoe, Maskelyne, and Rucker. It has its significance that such a humble representative of science as myself received invitations from working-class constituencies in more than a dozen of the leading manufacturing towns. In the next Parliament I do not doubt that a Minister of Education will be created as a nucleus around which the various educational materials may crystallise in a definite form.

III. *Science and Secondary Education.*—Various Royal Commissions have made inquiries and issued recommendations in regard to our public and endowed schools. The Commissions of 1861, 1864, 1868, and 1873 have expressed the strongest disapproval of the condition of our schools, and, so far as science is concerned, their state is much the same as when the Duke of Devonshire's Commission in 1873 reported in the following words:—"Considering the increasing importance of science to the material interests of the country, we cannot but regard its almost total exclusion from the training of the upper and middle classes as little less than a national misfortune." No doubt there are exceptional cases and some brilliant examples of improvement since these words were written, but generally throughout the country teaching in science is a name rather than a reality. The Technical Commission which reported last year can only point to three schools in Great Britain in which science is fully and adequately taught. While the Commission gives us the consolation that England is still in advance as an industrial nation, it warns us that foreign nations, which were not long ago far behind, are now making more rapid progress than this country, and will soon pass it in the race of competition unless we give increased attention to science in public education. A few of the large towns, notably Manchester, Bradford, Huddersfield, and Birmingham, are doing so. The working classes are now receiving better instruction in science than the middle classes. The competition of actual life asserts its own conditions, for the children of the latter find increasing difficulty in obtaining employment. The cause of this lies in the fact that the schools for the middle classes have not yet adapted themselves to the needs of modern life. It is true that many of the endowed schools have been put under new schemes, but as there is no public supervision or inspection of them, we have no knowledge as to whether they have prospered or slipped back. Many corporate schools have arisen, some of them, like Clifton, Cheltenham, and Marlborough Colleges, doing excellent educational work, though as regards all of them the public have no rights and cannot enforce guarantees for efficiency. A return just issued, on the motion of Sir John Lubbock, shows a lamentable deficiency in science teaching in a great proportion of the endowed schools. While twelve to sixteen hours a week are devoted to classics, two to three hours are considered ample for science in a large proportion of the schools. In Scotland there are only six schools in the Return which give more than two hours to science weekly, while in many schools its teaching is wholly omitted. Every other part of the kingdom stands in a better position than Scotland in relation to the science of its endowed schools. The old traditions of education stick as firmly to schools as a limpet does to a rock; though I do the limpet injustice, for it does make excursions to seek pastures new. Are we to give up in despair because an exclusive system of classical education has resisted the assaults of such cultivated authors as Milton, Montaigne, Cowley, and Locke? There was once an enlightened Emperor of China, Chi Hwangti, who knew that his country was kept back by its exclusive devotion to the classics of Confucius and Mencius. He invited 500 of the teachers to bring their copies of these authors to Pekin, and after giving a great banquet in their honour, he buried alive the professors along with their manuscripts in a deep pit. But Confucius and Mencius still reign supreme. I advocate milder measures, and depend for their adoption on the force of public opinion. The needs of modern life will force schools to adapt themselves to a scientific age. Grammar schools believe themselves to be immortal. Those reverse immortals—the Struldbrugs—described by Swift, ultimately regretted their immortality, because they found themselves out of touch, sympathy, and fitness with the centuries in which they lived.

As there is no use clamouring for an instrument of more compass and power until we have made up our minds as to the tune, Prof. Huxley, in his evidence before a Parliamentary Committee in 1884, has given a time-table for grammar schools. He demands that out of their forty hours for public and private study, ten should be given to modern languages and history, eight to arithmetic and mathematics, six to science, and two to geography, thus leaving fourteen hours for the dead languages. No time-table would, however, be suitable to all schools. The great public schools of England will continue to be the gymnasium for the upper classes, and should devote much of their time to classical and literary culture. Even now they introduce into their curriculum subjects unknown to them when the Royal Commission of 1868 reported, though they still accept science with timidity. Unfortunately the other grammar schools which educate the middle classes look to the higher public schools as a type to which they should conform, although their functions are so different. It is in the interest of the higher public schools that this difference should be recognised, so that, while they give an all-round education and expand their curriculum by a freer recognition of the value of science as an educational power in developing the faculties of the upper classes, the schools for the middle classes should adapt themselves to the needs of their existence, and not keep up a slavish imitation of schools with a different function. The old classical grammar schools may view these remarks as a direct attack upon them, and so it is in one sense, but it is like the stroke of Ithuriel's spear, which heals while it wounds.

The stock argument against the introduction of modern subjects into grammar schools is that it is better to teach Latin and Greek thoroughly rather than various subjects less completely. But is it true that thoroughness in teaching dead languages is the result of an exclusive system? In 1868 the Royal Commission stated that even in the few great public schools thoroughness was only given to 30 per cent. of the scholars, at the sacrifice of 70 per cent. who got little benefit from the system. Since then the curriculum has been widened and the teaching has improved. I question the soundness of the principle that it is better to limit the attention of the pupils mainly to Latin and Greek, highly as I value their educational power for a certain order of minds. As in biology the bodily development of animals is from the general to the special, so it is in the mental development of man. In the school a boy should be aided to discover the class of knowledge that is best suited for his mental capacities, so that, in the upper forms of the school and in the university, knowledge may be specialised in order to cultivate the powers of the man to their fullest extent. Shakespeare's educational formula may not be altogether true, but it contains a broad basis of truth—

"No profit grows, where is no pleasure ta'en:
In brief, sir, study what you most affect."

The comparative failure of the modern side of school education arises from constituting it out of the boys who are looked upon as classical wrecks. Milton pointed out that in all schools there are boys to whom the dead languages are "like thorns and thistles," which form a poor nourishment even for asses. If teachers looked upon these classical wrecks as beings who might receive mental nurture according to their natures, much higher results would follow the labours of our schools. Saul went out to look for asses and he found a kingdom. Surely this fact is more encouraging than the example of Gideon, who "took thorns of the wilderness and briars, and with these he taught the men of Succoth."[1] The adaptation of public schools to a scientific age does not involve a contest as to whether science or classics shall prevail, for both are indispensable to true education. The real question is whether schools will undertake the duty of moulding the minds of boys according to their mental varieties. Classics, from their structural perfection and power of analysing [illegible] faculties, have claims to precedence in education, but they have come to a practical monopoly. It is by claiming the latter that teachers sacrifice mental receptivity to a Procrustean uniformity.

The universities are changing their traditions more rapidly than the schools. The pons asinorum which leads to them is still broad, though a via moderna, with branching avenues, is now open to their honours and emoluments. Physical science, that was once neglected, is now encouraged at the universities. In the 70 per cent. of boys who leave schools for life-work and are not going through the universities, are there no growing signs of discontent which must force a change? The Civil Service, the learned professions, as well as the army and navy, are now barred by examinations. Do the boys of our public schools easily leap over the bars, although some of them have lately been lowered so as to suit the schools? So difficult are these bars to scholars that crammers take them in hand before they attempt the leap; and this occurs in spite of the large value attached to the dead languages and the small value placed on modern subjects. Thus, in the Indian Civil Service examinations, 800 marks as a maximum are assigned to Latin, 800 to Greek, 500 to chemistry, and 500 to each of the other physical sciences. But if we take the average working of the system in the last four years we find that while 68 per cent. of the maximum were given to candidates in Greek and Latin, only 43 per cent. were accorded to candidates in chemistry, and but [illegible] per cent. to the other physical sciences. Schools sending up boys for competition naturally shun subjects which are dealt with hardly and so heavily handicapped by the State.

Passing from learned or public professions to commerce, how is it that in our great commercial centres, foreigners—Germans, Swiss, Dutch, and even Greeks—push aside our English youth and take the places of profit which belong to them by national inheritance? How is it that in our colonies, like those in South Africa, German enterprise is pushing aside English enterprise? How is it that we find whole branches of manufactures, when they depend on scientific knowledge, passing away from this country, in which they originated, in order to engraft themselves abroad, although their decaying roots remain at home?[1] The answer to these questions is that our systems of education are still too narrow for the increasing struggle of life.

Faraday, who had no narrow views in regard to education, deplored the future of our youth in the competition of the world, because, as he said with sadness, "our schoolboys, when they come out of school, are ignorant of their ignorance at the end of all that education."

The opponents of science education allege that it is not adapted for mental development, because scientific facts are often disjointed and exercise only the memory. Those who argue thus do not know what science is. No doubt an ignorant or half-informed teacher may present science as an accumulation of unconnected facts. At all times and in all subjects there are teachers without aesthetical or philosophical capacity—men who can only see carbonate of lime in a statue by Phidias or Praxiteles, who cannot survey zoology on account of its millions of species, or botany because of its 130,000 distinct plants, men who can look at trees without getting a conception of a forest, and cannot distinguish a stately edifice from its bricks. To teach in that fashion is like going to the tree of science with its glorious fruit in order to pick up a handful of the dry leaves from the ground. It is, however, true that as science teaching has had less lengthened experience than that of literature, its methods of instruction are not so matured. Science and literary teaching have different methods; for while the teacher of literature rests on authority and on books for his guidance, the teacher of science discards authority and depends on facts at first hand, and on the book of Nature for their interpretation. Natural science more and more resolves itself into the teaching of the laboratory. In this way it can be used as a powerful means of quickening observation, and of creating a faculty of induction after the manner of Zadig, the Babylonian, described by Voltaire. Thus facts become surrounded by conceptions, and are subordinated to order and law.

It is not those who desire to unite literature with science who degrade education; the degradation is the consequence of its [illegible] refusal. A violent reaction—too violent to be wise—has lately

[1] Judges, viii. 16.

[1] See Dr. Perkin's Address to the Soc. Chem. Industry, Nature, August 6, 1885, p. 301.

the conservatives for education. In Mexico there is a species of ant which sets apart some of its individuals to act as honey pots by [illegible] storing their abdomens to store the precious food till it is wanted by the community. Professors in a university have a higher [illegible], because they ought to make new honey as well as to store it. The making of new branches of knowledge [illegible] scientific [illegible] is the crowning glory of university life. Germany unites the functions of teaching and research in the universities, while France keeps them in separate [illegible]. The German system is best [illegible], but as a condition [illegible] that [illegible] chairs should be greatly increased so that [illegible] should not be wholly absorbed in the duties of teaching [illegible] the [illegible] into scientific [illegible] and [illegible] special laboratories. It [illegible] university that the [illegible] give [illegible] their ability to make original research [illegible]. [illegible] teaching and [illegible] In [illegible] before the [illegible] Commission [illegible] that scientific men engaged in [illegible] with the duties of education, and [illegible] in support of this view when a single [illegible] for the [illegible] of a physical science [illegible]. But I hope that such a system will [illegible] long [illegible]. [illegible] it [illegible] we must occupy a very inferior [illegible] in the intellectual competition of Europe. Research and education in limited branches of higher [illegible]. It is true that Galileo complained [illegible] him for his [illegible] plainly [illegible] philosophers have echoed this [illegible]. Newton, who [illegible] orders in worlds, and [illegible], who [illegible] the range of order and number, [illegible] pupils. [illegible] astronomers [illegible] spread chemical [illegible] all over the world. [illegible], Liebig, [illegible], Lavoisier, Berthollet, and [illegible] as well as discoverers in France. In England [illegible] teachers. In fact, I recollect only three [illegible] men who were not—Boyle, Cavendish, and [illegible]. It was [illegible] as well as in modern times, for [illegible] and [illegible] and philosophical. If you do not [illegible] schoolmaster, as Dalton was, and [illegible] the present time, with the duty of teaching all branches of their sciences, the more elementary [illegible] as well as the highest generalisations being compressed into [illegible], it [illegible] they should be brought into contact with [illegible], so as to know its wants and [illegible]. They [illegible] the pregnant minds around [illegible] and [illegible] their best own power and [illegible] conception of this which he made:—

[illegible]

Our universities are [illegible] the [illegible] a proper combination of these [illegible] between [illegible] research. Even Oxford and Cambridge [illegible] have [illegible] in recent years in the equipment [illegible] according to their scientific staff [illegible] universities are [illegible]. The professors [illegible] among their growing, and will [illegible] of the learned professions, though they [illegible] of knowledge. Professors [illegible] abroad and [illegible] of the Ireland. [illegible] university [illegible] Bologna University [illegible] to the [illegible] by strong desire of the [illegible] more real knowledge. If their [illegible] which technical schools [illegible] would [illegible] at the eleventh [illegible] joined have been given [illegible] Scotland culture to the [illegible] on the pro- and Ireland [illegible] Oxford and [illegible] faculties, although [illegible] to Cambridge [illegible]. A greater [illegible] a more general [illegible] establishment [illegible] of science, the part of the State [illegible] the teaching of the for the sake of science and [illegible] their professions, would enable [illegible] part in the advancement of knowledge.

I have already alluded to the foundation of new colleges in different parts of the kingdom. Owens College has worthily developed into the Victoria University. Formerly the degrees for degrees on the University of London. No longer will she be like a moon reflecting cold and sickly rays from a distant luminary, for in future she will be a sun, a centre of intelligence, warming and illuminating the regions around her. The other colleges which have formed themselves in large manufacturing districts are remarkable expressions from them that science must be promoted. Including the colleges of a high class, such as University College and King's College in London, and the three Queen's Colleges in Ireland, the aggregate attendance of students in colleges without university rank is between nine and ten thousand, while that of the universities is fifteen thousand. No doubt some of the provincial colleges require considerable improvement in their teaching methods; sometimes they attempt [illegible] full university curriculum when it would be better for them to act as faculties. Still, they are all growing in the spirit of self-help, and some of them are destined, like Owens College, to develop into universities. This is not a subject of alarm to lovers of education, while it is one of hope and encouragement to the great [illegible] of industry. There are too few universities in England in proportion to its population. While Scotland, with a population of 3½ millions, has four universities with [illegible] students, England, with 26 millions of people, has only the same number of teaching universities with [illegible] students. Unless English colleges have such ambition, they may be turned into mere mills to grind out material for examinations and competitions. Higher colleges should always hold before their students that knowledge, for its own sake, is the only object worthy of reverence. Beyond college life there is a land of research flowing with milk and honey for those who know how to cultivate it. Colleges should at least show a Pisgah view of this Land of Promise, which stretches far beyond the Jordan of examinations and competitions.

V. *Science and Industry.*—In the popular mind the value of science is measured by its applications to the social purposes of life. It is no doubt true that science wears a beautiful aspect when she confers practical benefits upon man. But true relations of science to industry are implied in Greek mythology. Vulcan, the god of industry, wooed science, in the form of Minerva, with a passionate love, but the chaste goddess never married, although she conferred upon mankind nearly as many arts as Prometheus, who, like other inventors, saw civilisation progressing by their use while he lay groaning in want on Mount Caucasus. The rapid development of industry in modern days depends on the applications of scientific knowledge, while its slower growth in former times was due to experiments being made by trial and error in order to gratify the needs of man. When an hypothesis was less a questioning of Nature than an [illegible] on the mind of the experimentalist. For a true questioning of Nature only arises when intellectual conceptions of the causes of phenomena attach themselves to ascertained facts as well as to their natural environments. Much real science had at one time accumulated in Egypt, Greece, Rome, and Arabia, though it became obscured by the intellectual darkness which [illegible] Europe like a pall for many centuries. The [illegible] of the [illegible], fostered through the Romans and Arabians, gradually fertilised the soil of Europe [illegible] ages which are [illegible] to be dark and unprolific, substantial though slow progress was made. By the end of the eleventh century [illegible] the Alexandrian school had become the possession of Western Europe; Arabic numerals, algebra, trigonometry, [illegible], and an improved calendar having been added to its stock of knowledge. The old doctrines of Hero [illegible] and Archimedes in physics, and of Hipparchus and Ptolemy in astronomy, were producing their [illegible] though with great slowness. Many [illegible] [illegible], [illegible] chiefly by experience, and occasionally lighted up by glimmerings of science throughout the prevailing darkness, had arisen before the sixteenth century. A knowledge of the proportions of bodies, though scarcely of their relations to each other, came through the labours of the alchemists, who had a mighty impulse to work; for by the philosopher's stone, often not larger than half a rape's seed, they hoped to attain the three summum bonums of human ambition—gold, health, and immortality. By the end of the fifteenth century many important manufactures were founded by empirical experiment, with only the uncertain guidance of science. Among these were the compass, printing, paper, gun-

force. In industrial progress the sweat of the brow is lessened by the conceptions of the brain. How exultant is the old Greek poet, Antipater,[1] when women are relieved of the drudgery of turning the grindstones for the daily supply of corn. "Women! you who have hitherto had to grind corn, let your arms rest for the future. It is no longer for you that the birds announce by their songs the dawn of the morning. Ceres has ordered the water-nymphs to move the heavy millstones and perform your labour." Penelope had twelve slaves to grind corn for her small household. During the most prosperous time of Attica it was estimated that there were twenty slaves to each free citizen. Slaves are mere machines, and machines neither invent nor discover. The bondmen of the Jews, the helots of Sparta, the captive slaves of Rome, the serfs of Europe, and uneducated labourers of the present day who are the slaves of ignorance, have added nothing to human progress. But as natural forces substitute and become cheaper than slave labour, liberty follows advancing civilisation. Machines require educated superintendence. One shoe factory in Boston by its machines does the work of thirty thousand shoemakers in Paris who have still to go through the weary drudgery of mechanical labour. The steam power of the world, during the last twenty years, has risen from 11½ million to 29 million horse-power, or 152 per cent.

Let me take a single example of how even a petty manufacture improved by the teachings of science affects the comforts and enlarges the resources of mankind. When I was a boy the only way of obtaining a light was by the tinder box, with its quadruple materials, flint and steel, burnt rags or tinder, and a sulphur match. If everything went well, if the box could be found and the air was dry, a light could be obtained in two minutes; but very often the time occupied was much longer, and the process became a great trial to the serenity of temper. The consequence of this was that a fire or a burning lamp was kept alight through the day. Old Gerard, in his Herbal, tells us how certain fungi were used to carry fire from one part of the country to the other. The tinder box long held its position as a great discovery in the arts. The *Pyrotechnia* [illegible] of the Romans appears to have been much the same implement, though a little ruder, than the flint and steel which Philip the Good put into the collar of the Golden Fleece in 1429 as a representation of high knowledge in the progress of the arts. It continued to prevail till 1833, when phosphorus matches were introduced, though I have been amused to find that there are a few venerable ancients in London who still stick to the tinder box and for whom a few shops keep a small supply. Phosphorus was not a new discovery, for it had been obtained by an Arabian called Bechel in the eighth century. However it was forgotten, and was rediscovered by Brandt, who made a secret of its [illegible] making materials in order [illegible] had one secret [illegible] however, to be made before it could be used for lucifer matches. The science of combustion was only developed on the discovery of oxygen a century later. Time had [illegible] before chemical analysis showed the kind of [illegible] which will [illegible] to phosphorus so as to make it ignite readily. [illegible] till 1833 the matches became a [illegible] Unfortunately [illegible] were dangerous [illegible]. It required [illegible] makers and [illegible] in 1845 [illegible] another discovery [illegible] in order that these [illegible] safety match of [illegible] the present day. Now [illegible] by an science [illegible] 1833 we [illegible] made the [illegible] economy of time [illegible] when [illegible] demands for light that [illegible] matches per head [illegible] could have supplied [illegible] by an expert [illegible] supplies a light [illegible] minutes for the whole day [illegible] the [illegible] would require to [illegible] while the [illegible] the latter [illegible] about [illegible] shilling and sixpence daily [illegible] money to our [illegible] annually. This is a [illegible] instance of the manner in which science leads to economy of time and wealth even in a small manufacture. In larger industries the economy of time and labour produced by the application of scientific discoveries is beyond all measurement. Thus the discovery of latent heat by Black led to the inventions of Watt; while that of the mechanical equivalent of heat by Joule has been the basis of the progressive improvements in the steam-engine which enables power to be obtained by a consumption of fuel less than one-fourth the amount used twenty years ago. It may be that the engines of Watt and Stephenson will yield in their turn to more economical motors; still they have already expanded the wealth, commerce, and even the territories of England more than all the battles fought by her soldiers or all the treaties negotiated by her diplomatists.

The coal which has hitherto been the chief source of power probably represents the product of five or six million years during which the sun shone upon the plants of the Carboniferous period, and stored up its energy in this convenient form. But we are using this conserved force wastefully and prodigally; for although horse power in steam engines has so largely increased since 1804, two men only now produce what three men did at that date. It is only three hundred years since we became a manufacturing country. According to Prof. Dewar, in less than two hundred years more the coal of this country will be wholly exhausted, and in half that time will be difficult to procure. Our not very distant descendants will have to face the problem.

What will be the condition of England without coal? The answer to that question depends upon the intellectual development of the nation at that time. The value of the intellectual factor of production is continually increasing; while the values of raw material and fuel are lessening factors. It may be that when the dreaded time of exhausted fuel has arrived, its importation from other coal-fields, such as those of New South Wales, will be so easy and cheap, that the increased technical education of our operatives may largely over-balance the disadvantages of increased cost in fuel. But this supposes that future Governments in England will have more enlightened views as to the value of science than past Governments have possessed.

Industrial applications are but the overflowings of science welling over from the fulness of its measure. Few would ask now, as was constantly done a few years ago, "What is the use of an abstract discovery in science?" Faraday once answered the question by another, "What is the use of a baby?" [illegible] around that baby centre all the hopes and sentiments of its parents, and even the interests of the State, which interferes [illegible] its upbringing so as to ensure it being a capable citizen. The processes of mind which produce a discovery or an invention are rarely associated in the same person, for while the discoverer seeks to explain causes and the relations of phenomena, the inventor aims at producing new effects, or at least of obtaining them in a novel and efficient way. In this the inventor may sometimes succeed without much knowledge of science, though his labours are infinitely more productive when he understands the causes of the effects which he desires to produce.

A nation in its industrial progress, when the competition of the world is keen, cannot stand still. Three conditions only are possible for it. It may go forward, retrograde, or perish. In [illegible] extinction as a great nation follows its neglect of higher education, for, as described in the proverb of Solomon, "They that hate me love death." In sociology, as in biology, there are three states. The first of balance, when things grow neither better nor worse; the second that of elaboration or evolution [illegible] when animals adapt themselves to their environments; and third, that of degeneration, when they rapidly lose the [illegible] they have made. For a nation, a state of balance is only possible in the early stage of its existence, but it is impossible [illegible] its environments are constantly changing.

The possession of the raw materials of industry and the existence of a surplus population are important factors for the growth of manufactures in the early history of a nation, but afterwards they are found [illegible] while another factor—the application of intellect to their development. England could not be called a manufacturing nation till the Elizabethan age. No doubt wool, iron, and metal were in abundance, though, in the reign of the Plantagenets, they produced little prosperity. Wool was sent to Flanders to be manufactured, for England then stood in that relation to Holland as Australia now does to Yorkshire. The persecutions of Spain, from the reign of Ferdinand and Isabella to that of Philip II., destroyed it as a great manufacturing nation, and indirectly led to England taking its position. Spain, through the activity and science of the Arabian intellect, had

[1] Antipater [illegible]

[illegible]

to the utilities of life. Take the example of any man of learning, and see how soon the direct consequences resulting from it disappear in the life of a nation, while the discoveries of a man of science remain productive amid all the shocks of empire. As I am in Aberdeen I remember that the learned Dutchman Erasmus was introduced to England by the encouragement which he received from Hector Boece, the Principal of King's College in this University. Yet even in the case of Erasmus—who taught Greek at Cambridge and did so much for the revival of classical literature as well as in the promotion of spiritual freedom—how little has civilisation to ascribe to him in comparison with the discoveries of two other Cambridge men, Newton and Cavendish. The discoveries of Newton will influence the destinies of mankind to the end of the world. When he established the laws by which the motions of the great masses of matter in the universe are governed, he conferred an incalculable benefit upon the intellectual development of the human race. No great discovery flashes upon the world at once, and therefore Pope's lines on Newton are only a poetic fancy:—

> "Nature and Nature's laws lay hid in night,
> God said 'Let Newton be,' and all was light."

No doubt the road upon which he travelled had been long in preparation by other men. The exact observations of Tycho Brahe, coupled with the discoveries of Copernicus, Kepler, and Galileo, had already broken down the authority of Aristotle and weakened that of the Church. But though the [illegible] of the universe were thus [illegible], mankind had not yet rid themselves of the idea that the powers of the universe were still regulated by special providences. Even Kepler moved the planets by spirits, and it took some time to knock those celestial [illegible] on the head. Descartes, who really did on much by his writings to force the conclusion that the planetary movements should be dealt with as an ordinary problem in mechanics, looked upon the universe as a machine, the wheels of which were kept in motion by the [illegible] exercise of a divine power. Yet such theories were only an attempt to regulate the universe by celestial intelligences like our own, and by standards within our reach. It required the discovery of an all-pervading law, universal throughout all space, to enlarge the thoughts of men, and one which, while it widened the conceptions of the universe, reduced the earth and solar system to true dimensions. It is by the investigation of the finite on all sides that we obtain a higher conception of the infinite.

> "[illegible]
> [illegible]"

Ecclesiastical authority had been already undermined by earnest inquirers, such as Wycliffe and Huss, before Luther [illegible] the palace of the Vatican. [illegible] were confined within the [illegible] of their own [illegible]. Newton's discovery [illegible] made [illegible] as entirely new [illegible], and levelled many barriers to human progress. This intellectual result was vastly more important than the practical advantages of the discovery. [illegible] that navigation and [illegible] mightily benefited by our better knowledge of the motions of the heavenly bodies, [illegible] these benefits [illegible] are incomparably less in the history of progress than the expansion of the human intellect which followed the [illegible] the human [illegible] that [illegible] discard authority, and [illegible] marched forward without hindrance. [illegible] had been [illegible], Galileo had [illegible], and both Copernicus and Descartes [illegible] kept back their writings for fear of offending the Church.

The recent acceptance of evolution as [illegible] has had a like effect in producing [illegible] intellectual change in [illegible] thought than any mere impulse of industrial development. Already its application to sociology and education is [illegible]. Already its application [illegible] of less import to human progress than the [illegible] broadening of our views of Nature.

Abstract discovery in science is then the true [illegible] upon which the superstructure of modern civilisation is built; and the man who would take part in it should study science, and, if he can, advance it for its own sake and not for its applications. Ignorance may walk in the path lighted by advancing knowledge, but she is unable to follow when science passes her, for, like the foolish virgin, she has no oil in her lamp.

An established truth in science is like the constituent of an atom in matter—something so fixed in the order of things that it has become independent of further changes in the struggle for existence. The sum of such truths forms the intellectual treasure which descends to each generation in hereditary succession. Though the discoverer of a new truth is a benefactor to humanity, he can give little to futurity in comparison with the wealth of knowledge which he inherited from the past. We, in our generation, should appreciate and use our great possessions—

> "For me your tributary stores combine,
> Creation's heir; the world, the world is mine."

## SECTION A.

### MATHEMATICAL AND PHYSICAL SCIENCE.

OPENING ADDRESS BY PROF. G. CHRYSTAL, M.A., F.R.S.E., PRESIDENT OF THE SECTION.

WHEN a man finds himself unexpectedly in some unusual situation his first impulse is to look around and see how others have done in like circumstances. I have accordingly run through the addresses of my predecessors in the honourable office of president of Section A, which is fated this year to be filled somewhat unworthily. This examination has, I am bound to say, comforted me not a little. I have found precedents for all kinds of addresses, long and short, even apparently for none at all. The variety of subjects is also suggestive of great latitude. I have found reviews of the progress of mathematical and physical science, discussions of special scientific subjects, dissertations on the promotion of scientific research, and on the teaching and diffusion of science, all chosen in their turn for the subject of the opening address.

Following some of the most eminent of my forerunners, I propose to be brief; following the last of them, Prof. Henrici, I shall take for my subject, so far as I have one, the Diffusion of Scientific Knowledge. Apart from the fact that Prof. Henrici's address greatly interested me, and that I find many of his conclusions in agreement with the results of my own experience, and that, therefore, I wish to second him with all my power, I have other reasons for this choice. For more than half the year I am occupied with absolute continuity in teaching mathematics, and I have been so occupied for the last eight years or so that the other half has been mainly occupied in a variety of ways with something of teaching generally. This is the thing concerning which I have most experience, and I hold it to be the most respectful course towards my audience to speak to them on the subject that I know best.

Ever since I began to study science I have been deeply interested in the question of how it could best be taught. I believe my meditations in that direction were awakened by some [illegible] [illegible] efforts to apply to the satisfaction of a ploughman, who was my friend and confidant, certain principles of mechanical philosophy to explain the action of his plough. Whether [illegible] I have always been ardent about the improvement of scientific teaching, it was so long before I dreamt that I should one day be called upon to put my ideas through the cold ordeal of practice. It would not be becoming that I should speak [illegible] [illegible], regarding the success of my own efforts, or even regarding my alternate fits of hopefulness and despair. It is enough to say that, in such a cause,

> "[illegible] and lost,
> [illegible] loved at all."

The British Association, as its title, exists for the advancement of science. Now, I hold that one of the essential conditions for the advancement of science is the existence of a scientific public—a public eager to hear and tell of some new [illegible], and eager to criticise; ready to appreciate what is sound, to reject it if unsound. It [illegible] the British Association appeals, and [illegible] has not found its public wanting [illegible] of more friendly [illegible] participation in the dance.

I am not speaking now merely of a professional public, such as we possess in Germany for instance, made up of teachers and others professionally connected with science. I refer mainly to that amateur but truly expert public which has always been a honourable feature of English science, as examples of which I may mention Boyle and Cavendish in former days, and Joule and Spottiswoode in our own. It is quite true that much of that scientific public came in days of yore from the leisured class, whose trust to the rest of the nation will not improbably decrease in the course of our social development. I think, however, that the loss we may thus sustain will be more than compensated by the continual increase of those who have received higher education of some kind or other, and whose daily occupations give them an interest, direct or indirect, in one or more branches of science.

It may not be amiss to insist for a little on the advantages to science of a great body of men unofficially engaged in scientific research, in writing regarding science, or even in merely turning scientific matter over in their minds. It will not have escaped the notice of those among you who have studied the history of science, that few scientific ideas spring up suddenly without previous trace or history. It is perfectly true that in many cases some mind of unwonted breadth and firmness is required to formulate the new doctrine, and carry it to manifold fruition; but a close examination always shows that the sprite was in the air before the Prospero came to catch him. It is very striking to notice, in the history of Algebra for instance, long periods in which great improvements were effected in the science, which cannot be traced to any individual, but seem to have been due merely to the working of the minds of scientific men generally upon the matter, one giving it this little turn, another that, in the main always for the better. Like every other thing that has the virtue of truth in it, science grows as it goes, not like the idle gossiping tale by the casual accretion of heterogeneous matter, but by the chemical combination of pure element with pure element in reasonable proportion.

I know of no greater advantage for science than the existence of an army of independent workers sufficiently enlightened for self-criticism, who shall test the results and theories of their day. Great and indispensable as are the uses of professional schools of scientific workmen, they are open to one great and insidious danger. The temptation there to swear by the word of the master is often irresistible. Not to speak of its being often the readiest avenue to fame and profit, it is the perfectly natural consequence of the contact of smaller mind with greater.

There are few things where the want of an enlightened scientific public strikes an expert more than the matter of scientific text-books. If the British public were educated as it ought to be, publishers would not be able to palm off upon them in this guise the ill-paid work of fifth-rate workmen so often as they do; nor would the scientific articles and reviews in popular journals and magazines so often be written by men so palpably ignorant of their subject.

We all have a great respect for the integrity of our British legislators, whatever doubts may haunt us occasionally as to their capacity in practical affairs. The ignorance of many of them regarding some of the most elementary facts that bear on every-day life is very surprising. Scientifically speaking, uneducated themselves, they seem to think that they will catch the echo of a fact or the solution of an arithmetical problem by putting their ears to the sounding-shell of uneducated public opinion. When I observe the process which many such people employ for arriving at what they consider truth, I often think of a story I once heard of an eccentric German student of chemistry. This gentleman was idle, but, like all his nation, systematic. When he had a precipitate to weigh, instead of resorting to his balance, he would go the round of the laboratory, hold up the test-tube before each of his fellow-students in turn, and ask him to guess the weight. He then set down all the replies, took the average, and entered the result in his analysis.

I will not take up your time in insisting upon the necessity of the diffusion of science among that large portion of the public who are, or ought to be, appliers of scientific knowledge to practical life. That part of my theme is so obvious, and has been of late so much dwelt upon, that I may pass it by, and draw your attention to another place in which the shoe pinches. All of you who have taken any practical interest in the organisation of our educational institutions must be aware of the great difficulty in securing the services of non-professional men of sufficient scientific knowledge to act on School Boards, and undertake the direction of our higher schools. It is no secret among those who carefully watch the course of the times in these matters that our present organisation is utterly insufficient; that it has not solved, and shows every day less likelihood of solving, the problems of higher education. This arises, to a great extent, from the fact that a scientifically educated public of the extent presupposed by the organisation really does not at present exist.

If the existence of a great scientific public be as important as I think I have shown it to be, it must be worth while to devote a few moments to the consideration of the means we adopt to produce it both in the rising and in the risen generation.

It would naturally be expected that we should look carefully to the scientific education of our youth, to see that the best men and the best means that could be had were devoted to it; that we should endeavour to make for them a broad straight road to the newest and best of our scientific ideas; that we should exercise them when young on the best work of the greatest masters; familiarise them early with the great men and the great feats of science, both of the past and of the present; that we should avoid retarding their progress by making the details and illustrations or particular rules and methods end in themselves. Granting that it is impossible to bring every learner within reach of the fullest scientific knowledge of his time, it would surely be reasonable to take care that the little way we lead him should not be along some devious by-path, but towards some eminence from which he might at least *see* the promised land. The end of all scientific training of the great public I take to be, to enable each member of it to look reason and nature in the face, and judge for himself what, considering the circumstances of his day, may be known, and not be deceived regarding what must to him remain unknown. If this be so, surely the ideal of scientific education which I have sketched is the right one: yet it is most certainly not the ideal of our present system of instruction. To attain conviction on that head it is sufficient to examine the text-books and examination papers of the day.

Let us confine ourselves for the present to the most elementary of all the exact sciences, viz., geometry and algebra. These two, although among the oldest, are, as Professor Cayley very justly reminded the Association last year, perhaps the most progressive and promising of all the sciences. Great names of antiquity are associated with them, and in modern times an army of men of genius have aided their advance. Moreover, it cannot be said that this advance concerns the higher parts of these sciences alone. On the contrary, the discoveries of Gauss, Lobatschewsky, and Riemann, and of Poncelet, Mobius, Steiner, Chasles, and Von Staudt, in geometry, and the labours of De Morgan, Hamilton, and Grassman, not to mention many others, in algebra, have thrown a flood of light on the elements of both these subjects. What traces of all this do we find in our school books? To be sure ***antiquity*** is stamped upon our geometry, for we use the text-book of Euclid, which is some two thousand years old; but where can we point to the influence of ***modern*** progress in our geometrical teaching? For our teaching of algebra, I am afraid, we can claim neither the sanction of antiquity nor the light of modern times. Whether we look at the elementary, or at what is called the higher teaching of this subject, the result is unsatisfactory. With respect to the former, my experience justifies the criticism of Professor Henrici; and I have no doubt that the remedy he suggests would be effectual. In the higher teaching, which interests me most, I have to complain of the utter neglect of the all-important notion of algebraic form. I found, when I first tried to teach University students co-ordinate geometry, that I had to go back and teach them algebra over again. The fundamental idea of an integral function of a certain degree, having a certain form and so many coefficients, was to them as much an unknown quantity as the proverbial $x$. I found that their notion of higher algebra was the solution of harder and harder equations. The curious thing is that many examination candidates, who show great facility in reducing exceptional equations to quadratics, appear not to have the remotest idea beforehand of the number of solutions to be expected; and that they will very often produce for you by some fallacious mechanical process a solution which is none at all. In short, the logic of the subject, which, both educationally and scientifically speaking, is the most important part of it, is wholly neglected. The whole training consists in example grinding. What should have been merely the help to attain the end has become the end itself. The result is that algebra, as we teach it, is neither an art nor a science, but an ill-digested farrago of rules, whose object is the solution of examination problems.

The history of this matter of problems, as they are called, illustrates in a singularly instructive way the weak point of our English system of education. They originated, I fancy, in the Cambridge Mathematical Tripos Examination, as a reaction against the abuses of cramming bookwork, and they have spread into almost every branch of science teaching—witness test-tubing in chemistry. At first they may have been a good thing; at all events the tradition at Cambridge was strong in my day, that he that could work the most problems in three or two and a half hours was the ablest man, and, be he ever so ignorant of b[illegible] subject in its width and breadth, could afford to despise the less gifted with this particular kind of superficial sharpness. But, in the end, came all to the same; we were prepared for problem-working in exactly the same way as for bookwork. We were directed to work through old problem papers, and study the style and peculiarities of the day and of the examiner. The day and the examiner had, in truth, much to do with it, and fashion reigned in problems as in everything else. The only difference I could ever see between problems and bookwork was the greater predominance of the [illegible] element of luck in the former. This advantage was more than compensated for by the peculiarly depressed and, from a truly scientific point of view, worthless nature of the training which was employed to cultivate this species of mental athletics. The result, so far as problems worked in examinations go, is, after all, very miserable, as the concerted complaints of examiners show: the effect on the examinee is a well known enervation of mind, an almost incurable superficiality, which might be called Problematic Paralysis—a disease which unfits a man to follow an argument extending beyond the length of a quarto octavo page. Another lamentable feature of the matter is that an enormous amount of valuable time is yearly wasted in this country in the production of these [illegible] trifles. Against the occasional working and propounding of problems as an aid to the comprehension of a subject, and to the starting of a new idea, no one objects, and it has always been noted as a praiseworthy feature of English methods, but the abuse to which it has run is most pernicious.

All men practically engaged in teaching who have learned enough, in spite of the defects of their own early training, to enable them to take a broad view of the matter, are agreed as to the canker which eats everything that is good in our educational practice to-day. It is the absurd prominence of written competitive examinations that works all this mischief. The end of all education nowadays is to fit the pupil to be examined; the end of every examination ought to be an educational instrument, but to be an examination which a creditable number of men, however badly taught, shall pass. We reap, for we want to sow. Consequently our examinations, to be what is called fair—that is, [illegible] in the newspapers [illegible] students, for example, who [illegible] in his M.A. examination, and justly so [illegible] examiners, wrote [illegible] letter [illegible] was [illegible] that the paper set by the examiner [illegible] been answered out of Todhunter's Elementary Algebra. I have nothing to say, [illegible] Algebra? The course [illegible] thorough simplicity [illegible] at the same time, very ignorant and very [illegible] follows that lectures should contain [illegible] found in every text-book [illegible] since it is all in the text-book [illegible] would be [illegible] diction, there should be nothing [illegible] likely to be set in the examination. The [illegible] of a text-book has come now, in fact, to be [illegible] book [illegible] looking through it, [illegible] date [illegible] books I have seen [illegible] lady's waist in the nursery song [illegible] the publishers' advertisements. We shall return, I verily believe, [illegible] of all the [illegible] in the hands of [illegible] and higher into the light of day, while [illegible] educated are left more and more to wander in [illegible] darkness.

When our system sets such mean ends before the teacher, and encourages such unworthy conceptions of education, is it to be wondered at that the cry arises that pupils degenerate beneath even the contemptible standards of our examinations? These can hardly be made low enough to suit the popular taste. It is no merit of the system we pursue, but due simply to the better educated among our teachers—men, many of them, who work for little reward and less praise—that we have not come to a worse pass already. Some even of the much-abused crammers have conceptions of a teacher's duty far higher than the system-mongers of the day, whom it is their special business to outwit; and it is but fair to allow to such of these also as deserve it part of the credit of stemming the torrent of degeneration. We place our masters in positions such that their very bread depends upon their doing what many of them know and will acknowledge to be wrong. Their excuse is, "We do so and so because of the examination."

The cure for all this evil is simply to give effect to a higher ideal of education in general, and of scientific education in particular. Science cannot live among the people, and scientific education cannot be more than a wordy rehearsal of dead men's books, unless we have living contact with the working minds of living men. It takes the hand of God to make a great mind, but contact with a great mind will make a little mind greater. The most valuable instruction in any art or science is to sit at the feet of a master, and the next best to have contact with another who has himself been so instructed. No agency that I have ever seen at work can compare for efficiency with an intelligent teacher who has thoroughly made his subject his own. It is by providing such, and not by sowing the dragon's teeth of examinations, that we can hope to raise up an intelligent generation of scientifically educated men, who shall help our race to keep its place in the struggle of nations. In the future we must look more to men and to ideas, and trust less to mere systems. Systems have had their trial. In particular, systems of examination have been tested and found wanting in nearly every civilised country on the face of the earth. Backward as we are here, we are stirring. The University of London, after rendering a great service to the country by forcing the older universities to give up the absurd practice of restricting their advantages to persons professing a particular shade of religious belief, has for many years pursued its career as a mere examining body. It has done so with rare advantages in the way of Government aid, efficient organisation, and an unsurpassed staff of examiners. Yet it has been a failure as an instrument for promoting the higher education—foredoomed to be so, because, as I have said, you must sow before you can reap. At the present time, with great wisdom, the managers of that institution have set about the task of really fitting it out for the great end that it professes to pursue. If they succeed in so doing, they will confer upon the higher education one of the greatest benefits it has yet received. They have an opportunity before them of dethroning the iron tyrant Examination which is truly enviable. This movement is only one of the signs of the times. Among the younger generation I find few or none that have any belief in the "learn when you can and we will examine you" theory; and small wonder, for they have tasted the bitterness of its fruit. Examination as a method in the higher education no longer holds its place, except in the minds of some respected elderly people, who cling, not unnaturally, to the views and habits which were young when they were so.

All the same, the task of reformation is not an easy one. Examinations have a strong hold upon us, for various reasons, some good, some bad, but all powerful. In the first place, they came in as an outlet from the system of patronage, which, with many obvious advantages, some of which are now sorely missed, had become unsuited to our social conditions. There is a certain advantage in examinations from the organiser's point of view, which any one who, like myself, has to deal with large quantities of pretty raw material, will readily understand. Again, there is an orderly look about the system that pleases the business-loving eye of the Briton. Yearly the printed sheets go forth to every corner of the land. The candidates meet and, in the solemn silence of the examination hall, the inspector, the local magnate, or the professor, etc., while for two or three busy hours the pens go scratching over the paper. A feeling of thankfulness comes over the impartial actor in this well-ordered scene, that the younger generation have such advantages that their fathers never knew. It is only when the answers are dissected in the examiner's study that the rottenness is revealed underlying the fair outward skin. But then the examiner must go by his standards; he must consider what is done elsewhere, and what is to be reasonably expected. Accordingly he takes his report and quickly writes many per cent. passed. Then the chorus of reporting examiners lift up their voices in wonderful concordance; and all, perhaps even the examiners, are comforted. There is something attractive about the whole thing that I can only compare to the pleasure with which one listens to the hum of a busy factory or to the

numbers over 2,000 members; the granting of a Royal charter to the Institute of Chemistry; the changes introduced at the London University in the regulations for the D.Sc. degree; the report of the Royal Commission on Technical Education, in which the value to chemical manufacturers of advanced chemical knowledge is so fully recognised; the important conference on education held at the Health Exhibition last year; the recent agitation to found a teaching university in London with adequate provision for research—surely all these are signs that the value of higher education must and will ere long be generally recognised.

The neglect of chemical research in our British schools has often been forcibly commented upon—of late, especially, by an eminent past-President of this section, Dr. Perkin, whose opinion is of peculiar value, as he is not only world renowned as a chemist, but also as a manufacturer, indeed, as the founder of two distinct important chemical industries. There can be no doubt of the fact and of the dire consequences to our country of such neglect. How is it, then, that such pronounced complaints have been so mildly received; that hitherto they have produced comparatively so little effect, and that such slight encouragement is being given to those who, notwithstanding the many difficulties in their way, have steadfastly devoted themselves to research work? I question whether the value of such work has yet been brought home to teachers generally, let alone the public; the "[illegible]" is almost invariably met by pointing to some discovery of great pecuniary value as the [illegible] of research. This argument educationalists very properly refuse to [illegible] grasp. Too little has been said as to the value of the neglect so tersely and properly complained of. Hence it is that I propose again to take up what many may regard as a somewhat threadbare theme.

Every one will agree with Prof. Sir Henry R[illegible], who in his address last year to the Section said "that those who are to become either scientific or industrial chemists should receive as sound and extensive a [illegible] as in the theory and practice of chemical science as their time and [illegible] will allow rather than they should be [illegible] prematurely [illegible] "into the [illegible] of a few [illegible] to [illegible] contemporaneously, in the investigation of some [illegible] reaction, or [illegible] possible new colouring matter, though such work might [illegible] lead to publication." We must also cordially agree with him that the aim should be, as he tells us his has been "to prepare a young man by a careful and fairly complete general training to fill with intelligence and [illegible] a post [illegible] chemist, rather than to turn out mere specialists, who, placed under other conditions than those to which they have been accustomed, are unable to get out of the narrow groove in which they have been trained." If it were necessary to [illegible] that Sir Henry Roscoe [illegible] [illegible] would be afforded by his statement, "[illegible] under rating the educational advantage of working [illegible] be considered [illegible] training [illegible] kind, but only useful when founded upon [illegible] basis."

But I venture to think that [illegible] in order to completely [illegible] the slight amount of original work which [illegible] better. We [illegible] that [illegible] power and [illegible] chemist who has [illegible] owing to the [illegible] research, [illegible] of accuracy [illegible] and the industrial chemist [illegible] those faculties [illegible] investigation, and which [illegible] perhaps will [illegible] any other [illegible] In a works [illegible] as long as [illegible] goes well. The [illegible] products can be controlled by purely [illegible] analysis by the usual analyst, or by [illegible]. But things never [illegible] well [illegible] are always arising [illegible] of the materials [illegible] understand his [illegible] has to be effected—which cannot be done unless [illegible] which he is working he understand, as well as the character of the changes which are taking place. Investigation is therefore necessary at every step. No amount of [illegible] as is ordinarily given, in the mere theory and practice of chemical science will confer the habits of mind, the accuracy of vision and resourcefulness required of an efficient chemist in a works,

any more than the mere placing of the best tools in a workman's hands will make him a skilful operator.

Such being our position, we maintain that it is essential to make research an integral portion of the student's course in every college which pretends to *educate chemists*. It will not suffice occasionally to set a promising student to investigate, but a number of students, as well as the staff, must always be engaged in original work: in fact, *an atmosphere of research must pervade the college*. It cannot be too clearly recognised that it is this which characterises and distinguishes the German schools at the present time. The student does not learn so much from the special piece of work with which he is occupied, but a number of his fellow-students being also similarly engaged, the spirit of inquiry is rife throughout the laboratory: original literature is freely consulted, and they thus become acquainted with the methods of the old masters; vigorous discussions take place not only in the laboratory, but also at that most useful institution the "Kneipe"; the appearance of each new number of the scientific periodicals is keenly welcomed;—in fact, a proper spirit of inquisitiveness is awakened and maintained, until it gradually becomes a habit. Probably there is less actual routine teaching done by the staff in the German schools than in our own. I am proud to own my indebtedness to one of them, and I can without hesitation say that I never truly realised what constituted the science of chemistry until I came under its influence.

But to realise the state which I have pictured—*to create an atmosphere of research in our science colleges in order that it may be possible for our students to obtain complete training in them*—[illegible] several things are required. In the first place, it will be necessary that the students come to them better prepared than they are at present; as a rule they are so ill-prepared that it is very difficult, if not impossible, in the time at disposal to give such preliminary instruction as is indispensable before higher work can be attempted. Their mathematical knowledge is in general [illegible] that it is more often than not necessary to begin by teaching simple proportion, and they look aghast at a logarithm [illegible]. They cannot draw; so far have we advanced in our [illegible] that the subject is more often than not so "[illegible]" in our schools. They understand a little French; but German, which may almost be called the language of modern science, is [illegible] an unknown tongue to them. I do not complain of their want of knowledge of science subjects, but of the [illegible] the manner in which they have been trained at school, and especially of the manner in which their intellectual faculties have become deadened from want of exercise, instead of developed [illegible]. Too many have never acquired the habit of working steadily and seriously; they have not learnt to appreciate the holiness of work,[1] so that they render the office of teacher akin rather to that of slave-driver instead of to that of friend. What is perhaps worst is their marked inability, often amounting [illegible], either to take proper notice of what happens in an experiment or to draw any logical conclusions from [illegible]. Man is said to be a reasoning being, but my experience as an examiner and teacher would lead me to believe that this fact is altogether lost sight of by the average schoolmaster, who [illegible] to confine himself almost exclusively to [illegible], and makes no attempt to cultivate those very faculties which are supposed to characterise the [illegible] ill-prepared for his work that he fails to [illegible]. These are hard words, but the evil is [illegible] that it cannot be too plainly stated. [illegible] brought full face to it fail in their duty if [illegible] they do not take occasion at all [illegible].

[illegible] the most effectual, and [illegible] applied—is the introduction of a [illegible] practical science teaching into all our schools [illegible] effect would be that all the other [illegible] be taught in a more scientific manner [illegible] those who would eschew the teaching [illegible], and I [illegible] to see science teaching introduced [illegible], in order that the students who come to [illegible] some knowledge of science [illegible] that they shall not; but I desire [illegible] the faculty of observing and of reasoning from observation, and also from experiment, is most really

[1] [illegible]

majority will not be required to perform *ordinary* analyses, either qualitative or quantitative; it will be sufficient for them to have gained such an amount of practical experience that they thoroughly understand the principles of analysis; that they shall have learnt to appreciate the exactness of accuracy, and that they shall have acquired sufficient manipulative skill to be able when occasion requires to carry into execution the analytical process which their text-books tell them is applicable, and even, if necessary, to modify the process to suit circumstances.

Chemistry is no longer a purely descriptive science. The study of carbon compounds and Mendeleeff's generalisation have produced a complete revolution. The faults in our present system are precisely those which have characterised the teaching of geography and history, and which are now becoming so generally recognised and condemned: in fact, no better statement of the manner in which I conceive chemistry should be taught could be given than by literally applying to the teaching of chemistry what was said by Professor [illegible] at the International Conference on education last year, in an important paper on the teaching of history.

The necessity for some change must, I venture to think, be patent to all thoughtful teachers, and especially to those who are called upon to fulfil the painful duties of an examiner. The railway book-stalls have made us acquainted with "Confessions" of all sorts, but if the "Confessions of an Examiner" were to be written they would be far more heartrending than any. The examiner in chemistry, let him go where he will, scarcely dare to ask a question to which the answer cannot be directly read out from a text-book. He will be told "that such and such a compound is formed by the action of [illegible] upon so and so," but he will usually find blank ignorance of the phrase "by the action of," and as to the mode of performing the operation. The examiner would, however, be bound to agree with the teacher that it is almost impossible to induce students to seek information outside the lecture-room, and except in the ordinary cram text-books, and that it is hopeless to expect them to devote attention to anything unless it will pay in a subsequent examination—in fact that the old university spirit of acquiring knowledge for its own sake is almost unknown among our science students. Herein lies one of the teacher's most serious difficulties, as he is more often than not bound to teach in a particular way, or to teach certain subjects, in entire opposition to his own views, in order to qualify his students to pass a particular examination; for example, many of our colleges now distinctly state that their courses are intended to qualify students to pass the examinations of the London University, and hence they are governed by the requirements of that university, which vary more or less as the examiners are periodically changed. The examiner, on the other hand, is often placed in a difficult position: it is clear to him that the system under which the students he is called upon to examine have been taught is a bad one, yet he feels that he has no right to set questions such as he honestly believes should direct the teaching into proper channels, because he knows that the teacher is irremovable, and it is not fair to make the examinees the victims of a system for which they are not responsible. Hence, perforce, the teacher goes on teaching badly and the examiner examining badly. Difficulties of this kind are bound to make themselves felt at a transition period like the present, and will only disappear if we recognise the grave responsibility which rests upon ourselves and improve our method of teaching and our text-books. These, in too many instances, are constructed [illegible] repetitions, and are being made worse by [illegible], and the practice which is gradually creeping in of merely changing the date on the title-page and the numeral before the word "edition," thus suggesting the belief that the information is given up to date.

Both in teaching and examining two important changes ought forthwith to be made: our students ought at the very beginning of their career to become familiar with the use of the [illegible], and the imaginary distinction between so-called inorganic and organic compounds should be altogether abandoned. I do not mean that students should be taught quantitative analysis [illegible] sufficiently understood, but that instead of endeavouring to make clear to them by explanation only the meaning of terms such as equivalent, for example, we should set them to perform a few simple quantitative exercises in determining equivalents, &c. It can easily be done, and terms which otherwise long remain mythical acquire a real meaning in the student's mind. The elements of the chemistry of carbon compounds should not find

a place at a very early period in the course of instruction [illegible] of those riddles connected with our system which it is [illegible] to answer. Attention was once pithily directed to the [illegible] my hearing by a scientific friend—not a chemist—who said he had often felt astonished that, although he had learnt a great deal of chemistry, the chemistry of the breakfast table was practically a sealed book to him, common salt being the one thing of which he felt he knew something.

I may here urge that there is one great error which we must avoid in the future, that of overworking our students, in the sense of obliging them to pay attention to too many subjects at a time. This is done more or less, I believe, in all our science schools, and medical students are peculiarly unfortunate in this respect. It is to some extent necessitated by the defective preliminary education of our students; but I believe that I am justified in stating that it is also partly, perhaps mainly, due to the fact that the curriculum is too often imposed by persons who are directly interested in the attendance of students at their lectures. This is one of the great difficulties in the way of higher education, and the continuance of the evil is probably in a measure due to misappreciation of what constitutes higher education and culture: neither consist in a smattering of knowledge of a variety of subjects such as is too often required at present.

The more general appreciation of the value of science undoubtedly depends to a considerable extent on improvements such as I have indicated being introduced. When such is the case we may hope that a large number of students will enter our chemical schools, not with the intention of becoming chemists, but because it will be recognised that the training there given is of high educational value, and that a knowledge of chemistry is of distinct service in very many avocations.

We may also hope that it will be possible ere long to teach chemistry properly to medical students. Seeing that the practice of medical men largely consists in pouring chemicals into that delicately organised vessel, the human body, and that the chemical changes which thereupon take place, or which normally and abnormally occur in it, are certainly not more simple than those which take place in ordinary [illegible] vessels in our laboratories, the necessity for the medical man to have a knowledge of chemistry—and that no slight one—would appear to ordinary minds to stand to reason; that such is not generally acknowledged to be the case can only be accounted for by the fact that they never yet have been taught chemistry, and that the apology for chemistry which has been forced upon them has been found to be of next to no value. No proof is required that no student has ever performed a single quantitative exercise, and I have no hesitation in saying that the examinations in so-called practical chemistry, even at the London University, are beneath contempt: after more than a dozen years' experience as a teacher under the system, I can affirm that the knowledge gained is of no permanent value, and the educational discipline nil. How is reform to be effected? By the examining boards: it is for them to insist upon a satisfactory preliminary training, and they must so order their demands as to enforce a proper system of practical teaching; and if chemistry is to be of real service to medical men, more time must be devoted to its study. Physiological chemistry is taught nowhere in our country, either at the universities or at any of our great medical schools; let us hope the publication of works like those of Gamgee and Lauder Brunton may have some effect in calling attention to the present neglect of so important a subject.

Having dealt with the educational aspect of the question, let me now briefly refer to some other difficulties which surround the higher research. It has been more or less openly stated that the teachers in our chemical schools ought themselves to do far more. Is this the case? I do not think so; I believe it is not the teachers, in most cases, who are primarily at fault. Under our peculiar system of placing the government of science schools in the hands of those who have little, if any, experience as educationalists, and little knowledge of or sympathy with science, the appointments are sometimes made without the slightest reference to capability of initiating and conducting original investigation, and without any proof having been given either of a desire to promote higher education in the only possible way—by research; nevertheless experience shows that, as a rule, but little is made by teachers of their opportunities. The opportunities afforded to our teachers are few. In the first place, the amount of actual routine teaching they are called upon to perform is very considerable, many of us having to conduct evening as well as day classes; and the work is often of the most harassing description, owing to the want of [illegible] displayed by the students. The assistance provided is also too often inadequate, and much which should be done by assistants is therefore thrown upon the principals. Higher work under these conditions is practically out of the question, not so much because it is impossible to snatch at intervals a few hours per week, but because the [illegible] is so much taken up in the preparation of lectures and [illegible] and tutorial teaching that it is impossible to secure the freedom of mind and concentrated attention which are essential to the successful prosecution of research. Bad, however, as is often the position of the principals, that of the juniors is [illegible] worse. [illegible] they are entirely occupied in tutorial work, and what little energy remains must more often than not be devoted to teaching or literary work, to supplement the too modest income which the salary attached to their official position affords. [illegible]

[illegible]

bearing. If I thought so I should never make the suggestion. But it would not, provided that complete academic freedom were granted to the staff, and each college were left to adapt itself to local requirements, efficiency would be maintained by the competition of the various colleges. Local enterprise [illegible] clearly breaking down under the tremendous strain of modern educational requirements [illegible]

(*To be continued.*)

SECTION C

GEOLOGY

OPENING ADDRESS BY PROF. J. W. JUDD, F.R.S., SEC. G.S., PRESIDENT OF THE SECTION.

[illegible]

[illegible]

but that in other places they appear to be overlain conformably by, and even to alternate with, crystalline schists and gneisses. He was further able to state that the quartzites of his "Primary Red Sandstone Formation" contain organic remains, some of which he correctly identified as the burrows of marine worms, while others he recognised as *Orthoceratites* ("Western Isles of Scotland" (1819), vol. ii. pp. 512, 513). It is almost painful to have to add that his want of appreciation of the value of palæontological evidence, a weakness which Macculloch shared with so many of the early Scottish geologists, prevented any attempt on his part at the correlation of this "Primary Red Sandstone" with the [illegible]; and thus for more than forty years this important discovery remained almost entirely fruitless.

The next step in the history of our knowledge of these Highland strata which we [illegible], was undoubtedly a retrograde one. Sedgwick and Murchison, who visited the district in 1827, [illegible] that Macculloch had fallen into grievous error, and that his "Primary Red Sandstone Formation" was in fact no other than an outlying part of the Old Red Sandstone (*Trans. Geol.* [illegible] 2, vol. iii. p. 155).

This view was strongly [illegible] against by Hay Cunningham, who, writing in 1839, after a careful survey of Sutherland, demonstrated the [illegible] of Macculloch's conclusions, and even went beyond that geologist in showing the very intimate connection between the quartzite and limestone. He clearly illustrated by numerous sections the unconformity of the "Primary Red Sandstone Formation," consisting of red sandstone, quartzite, and limestone, upon the gneissose rocks, and the apparently conformable superposition [illegible] of other schists and gneisses ("On the Geognosy of Sutherlandshire," by R. [illegible] H. Cunningham, M.W.S.; *Transactions of the Highland and Agricultural Society of Scotland*, vol. [illegible], 1839).

Such was the state of geological opinion when, in the winter of 1854, the attention of geologists was recalled to this ancient formation of Macculloch by the discovery in it of fossils by one who fully recognised their value and importance—Mr. Charles Peach. These fossils, though imperfect, were sufficient to prove that the strata containing them must be of *Palæozoic* age.

Three of the leaders of geological [illegible] at that day appear to have been deeply impressed with the importance of this discovery of Mr. Peach's; but for a time, at least, the fruit of that discovery were missed, through the [illegible] retrograde teachings of Sedgwick and Murchison in 1827.

Hugh Miller, whose splendid researches in the Old Red Sandstone had made him ready to welcome any extension of its boundaries, suggested that the fossiliferous [illegible] might belong to the marine Devonian.

Roderick Murchison, who in his younger days had [illegible] conquered a kingdom in Siluria, and by successive advances [illegible] in his later years had sought to [illegible] his kingdom [illegible] an empire—one which should embrace all the Lower Palæozoic rocks of the globe—[illegible] now unwilling to claim his native Highlands as part of this [illegible].

James Nicol, who had [illegible] the rocks of the [illegible], and [illegible] the [illegible] slaty [illegible] of the Highlands [illegible] notice distinct, [illegible] discovery, [illegible] suggested the probability [illegible] Highland schists and gneisses [illegible] simply the [illegible] shales and greywackes in an altered state [illegible] to the Geology of [illegible] land" (1844)). Hence Nicol, equally with Murchison, was prepared to accept the [illegible] age of the [illegible] limestone, and of the rocks associated with it.

Murchison, with [illegible] his [illegible] enthusiasm [illegible], determined to lose no time in putting [illegible] the [illegible] of the suggestion made by his old friend Nicol and himself; and accordingly, shortly before the meeting of the British Association, which was fixed to take place in the year 1855 at Glasgow, we find the two [illegible] making their way into the wilds [illegible] of North-west Sutherland.

Unfortunately the time was too short and the weather too unpropitious for the task they had set before themselves.

When the Geological Section assembled at Glasgow, Murchison declared his conclusion that the limestone of Durness, which had yielded the fossils to Mr. Peach, was of Silurian age—that is, as he employed the term—of Lower Palæozoic age. But he, at the same time, maintained the truth of his old views that the red sandstones of Applecross and Gairloch are in reality nothing but Old Red Sandstone ("Rep. Brit. As." [illegible] 1855; *Trans.* of Sec. p. 87), and in this latter contention he received the warm support of Sedgwick, who was also present at the meeting (Geikie's "Memoir of Sir Roderick Murchison" (1875), vol. ii. p. 207).

Nicol, on the other hand, appears to have been greatly dissatisfied with the results of this hasty and inauspicious journey to Sutherland. While, however, withholding his judgment as to the age of the several rock-masses, he insisted, in opposition to the views of Murchison and Sedgwick, that the whole of the vast series of Red Sandstones in Applecross and Torridon is, as Macculloch showed, inferior to the quartzite and limestone (see Nicol's "Geology of the North of Scotland" (18[illegible]), Appendix, p. 96).

In the summer of the next year, 1856, Nicol, as soon as he was released from his teaching work in this university, hastened back to the Western Highlands to try and resolve some of the doubts which troubled him concerning the age and sequence of the strata. This summer's labour was productive of great and important discoveries. In the first place, he was able to completely confirm the conclusions of Macculloch and Hay Cunningham, that *all* the Red Sandstone of the Western Islands, with the exception of some small patches of "New Red," belongs to an old formation underlying the quartzite and limestone. In his researches also enabled him to show that Macculloch's "Primary Red Sandstone" in reality consists of *two* formations, the lower—to which he subsequently gave the name of the "Torridon Sandstone"—lying unconformably on the gneiss, and the upper (consisting of quartzite and limestone, containing fossils) resting everywhere unconformably upon, and overlapping, the sandstones.[1] It is a very noteworthy circumstance that, while Nicol admitted the accuracy of the descriptions of Macculloch and Hay Cunningham which seemed to point to a conformable superposition of beds of gneiss to the quartzite and limestone, the results of this first summer's work had already raised some misgivings in his mind as to the correctness of this conclusion, for he wrote as follows:—"The fact of the overlying gneiss having been metamorphosed *in situ*, and not pushed up over the quartzite, is one requiring further investigation" (*Quart. Journ. Geol. Soc.*, vol. xiii., 1857, p. 35). It is not surprising, however, to find that Nicol was so staggered by the magnitude of the faults which would be required to bring about such a result, that for more than a year he hesitated to accept this, what we now know to be the true, explanation of the phenomena.

There was a suggestion—and it was nothing more than a suggestion—made by Nicol at this time, which has often been very unfairly quoted to his disadvantage. Convinced that Macculloch was right as to the infraposition of the Torridon Sandstone to the quartzite and limestone, and strongly inclined to accept Murchison's confident assertion that this Torridon Sandstone was simply the "Old Red," Nicol pointed out that the only possible way of harmonising these two views was to suppose that the quartzite and limestones were of Carboniferous age; and he showed that the imperfect fossils which had been up to that time obtained at Durness were not sufficient to negative such a supposition (*Quart. Journ. Geol. Soc.*, vol. xiii., 1857, p. 36).

But during the summers of 1857 and 1858, Nicol continued his researches in the Western Highlands, with the result of clearing away many of his difficulties and perplexities. Murchison, too, had [illegible] the [illegible], and seen that his idea of the "Old Red" age of the Torridon Sandstone would have to be finally abandoned, and that Macculloch's views, as amended by Nicol, concerning the relations of the Highland rock-masses must be accepted. [illegible] the [illegible] more perfect specimens of fossils which had in the meanwhile been obtained from the Durness limestone by the indefatigable Mr. Charles Peach showed that they were certainly of *Lower* Palæozoic age (Silurian of Murchison).

The position taken up by Murchison, and on which he made his final stand, was simply arrived at by combining the stratigraphical conclusions of Macculloch and Nicol with the palæontological results of Peach and Salter.

Murchison attended the meetings of this Association at Dublin in 1857, and at Leeds in 1858, on both occasions making use of the opportunity for expounding in detail his ideas concerning the age and succession of the Highland rocks. On the later [illegible]

[1] [illegible] Sir Henry [illegible] is said to have made similar observations during the same summer [illegible] of 1856, and to have communicated them to Sir Roderick Murchison [illegible]. But there can be no doubt that Nicol's discovery was [illegible] independently, and he was the first to publish it.

Most completely have these anticipations of Nicol been fulfilled. During the last seven years many of the sections of the Western Highlands have been visited by different geologists, Dr. Hicks leading the way, and not a few papers have been published embodying the results of these new studies of some of the disputed points. Such an able review of this recent work has been lately drawn up by my friend, Prof. Bonney, in his Anniversary Address to the Geological Society, that I need not go over the ground again, but will content myself by referring to that address and to two exhaustive papers read by Dr. Hicks before the Geologists' Association for full details concerning this later work. It will be seen that while new methods of study have enabled them to improve or correct Nicol's petrological nomenclature, the principal conclusions of nearly all these writers concerning the relations of the several rock-masses entirely support his views on the subject.

But very recently Nicol's work has been tested in the way which he himself so earnestly desired. Prof. Lapworth, who, like Nicol, was especially prepared for the task by long and patient study of the crumpled Silurian rocks of the Borderland, taking advantage of the newly published Ordnance maps of Sutherland, proceeded in the summer of 1882 to Eriboll, bent on the task of unravelling the complicated rocks and of mapping them upon the large scale of 6 inches to the mile. Prof. Lapworth's detailed maps and sections were exhibited to the Geological Society on May 9, 1883, during the reading of a paper by Dr. Callaway, in which the views of Nicol also received a considerable amount of valuable support.

In the same year, 1883, a detachment of the Geological Survey of Scotland, under the superintendence of Messrs. B. N. Peach and J. Horne, commenced the detailed mapping of the Durness-Eriboll district. How admirably these gentlemen have performed their task we all know, and I hope that some interesting information concerning their conclusions will be laid before the present meeting. In offering them—as I am sure that I am empowered by you to do—the hearty congratulations of the Geological Section of the British Association upon the auspicious commencement of this great undertaking, I cannot refrain from reminding you that, of the leaders in this important enterprise, one is the son of the discoverer of the Durness fossils, the veteran Mr. Charles Peach to whom we owe so much, while the other is a very active and efficient local secretary of this Section.

Nor should I do justice to my own sentiments on the subject if I failed to bear tribute to the judgment displayed by the present chief of the Geological Survey in his choice of a base from which to attack this difficult problem, to his loyalty in accepting results so entirely opposed to his published opinions, and to his promptitude in making his fellow-workers in geology acquainted with these important discoveries. Unfortunately called upon while still young, and with but little of that ripe experience which he has since gained, to grapple with the most intricate of problems—problems which the most practised of field-geologists might be forgiven for failing to solve—his own judgment yielded, though not without serious misgivings (see "Memoirs of Sir Roderick Murchison" (1875), vol. ii. p. 238) when opposed to the ardent confidence of a companion and friend whose reputation in the scientific world commanded his respect, and whose previous achievements had won his complete reliance. If, like your own Randolph at Bannockburn, he has "lost a rose from his chaplet" at the commencement of this great Highland campaign, we are well assured that the error will be worthily repaired in its subsequent stages.

The conclusions arrived at by Nicol, by Professor Lapworth, and by the officers of the Geological Survey, are, in all their main features, absolutely identical; and the Murchisonian theory of Highland succession is now, by universal consent, abandoned.

In the second of the great controversies to which we have alluded as having occupied the attention of this Geological Section in 1859—that concerning the age and relations of the Reptiliferous Sandstone of Elgin—the combatants were found ranged in quite a different order. Nicol is seen battling shoulder to shoulder with Murchison, Ramsay, and Harkness, in favour of the *Palæozoic* age of the beds in question; while Lyell, supported by Symonds of Pendock and Moore of Bath, is as stoutly maintaining their *Secondary* age.

The finding by Mr. Patrick Duff, in the year 1852, of the little fossil lizard called *Telerpeton*, and the determination of its true nature by Mantell and Owen, constitute a discovery comparable in importance and fruitfulness to Mr. Peach's detection of the fossiliferous character of the limestone of Durness; up to that time no doubt had ever been entertained as to the "Old Red" age of the yellow sandstone of Elgin. For bringing together the remarkable fossils of these rocks, geologists are indebted to the untiring labours of Dr. Gordon of Birnie—whom, full of years and honours, and the object of such universal respect and love as indeed make grey hairs a "crown of glory," we rejoice to have still in our midst. Studying Dr. Gordon's important collections, Professor Huxley was able, shortly before the previous meeting of the Association in this city, to announce that a crocodilian (*Stagonolepis*), and a second lizard of Triassic affinities (*Hyperodapedon*), existed at the period when these beds were deposited, so that even in 1859 the palæontological evidence in favour of the Mesozoic age of these rocks was admitted to be almost overwhelming.

But this evidence has been very greatly strengthened since that date; for Professor Huxley has shown that the genus *Hyperodapedon* is represented in the Trias of Warwickshire, of Devonshire, and of India. In the same reptiliferous sandstone, with its abundant footprints, the teeth of *Ceratodus*, a fish unknown in the Palæozoic rocks, have been found, together with the remains of a reptile which Professor Huxley permits me to state is, in his opinion, probably *Dinosaurian*. I am sure that you will all join with me in the hope that the health of the President of the Royal Society may soon be so far restored that he may be able to return to the examination of these fossil reptiles of Elgin, in the study of which some of the earliest of his great palæontological discoveries were achieved.

The manner in which the yellow sandstones, which have yielded these reptilian remains, are at many different parts found associated with beds containing *Holoptychius* and other Old Red Sandstone fish, appeared to many geologists altogether inexplicable on any other hypothesis than that the strata are all of the same geological age.

In spite, however, of these appearances, and the interesting observations of Dr. Gordon and Dr. Joass on the rocks of the Tarbet peninsula, which seemed to support the hypothesis just referred to, I am able to announce that proof of the most clear and convincing character now exists of the distinction between the fish-bearing "Old Red" and the reptiliferous "New Red" of the neighbourhood of Elgin. In the year 1873 I showed that rocks, identical in character with the reptiliferous sandstone of Elgin, and the overlying calcareous and cherty rock of Stotfield, exist on the northern side of the Moray Firth, in the county of Sutherland, and that they there conformably underlie Keuper and Liassic strata. Very recently Dr. Gordon has added a crowning discovery to his long list of previous ones, by detecting in the same quarry the rocks containing the reptilian and fish remains respectively. I find, however, that while the two series of beds present well-marked differences in their mineral characters, the yellow sandstones with fish remains clearly overlie the undoubted Upper Old Red, and are separated from it by a well-marked bed of conglomerate. In other quarries in the district, the manner in which these two series of strata have been thrown side by side by the action of great faults is very clearly exhibited. I hope that full details of the evidence on this interesting subject will be laid before you during the present meeting.

The facts relied upon by the Palæontologist and the [illegible]graphist respectively are thus found to be no longer [illegible] one another. By a complicated series of parallel faults [illegible] Devonian and Triassic sandstones, which happen to have a general resemblance in their mineral characters, are found again and again thrown side by side with one another in the Elgin district, so that the error into which geologists fell [illegible] discovery of the distinctive fossils of the two ages [illegible] a very pardonable one.

A retrospect [illegible]
at rest [illegible]
land [illegible]
war[illegible]
pre[illegible]

[illegible]fer to them; but in the third of this series of papers [illegible] in 1878 (*Q. Journ. Geol. Soc.* vol. xxxiv. p. 660), I had no [illegible] this terminology for that of Nicol.

thickness. Resemblances in mineral character have been proved not only to have been, at their best, very unsafe guides indeed, but to have actually betrayed those who trusted in them into the most serious errors. But for the discoveries of Charles Peach on the one hand, and of Patrick Duff and Dr. Gordon on the other, geologists would probably still continue to class the sandstones of Torridon and Elgin respectively with the "Old Red."

But perhaps the consideration of greatest importance which is impressed upon us by this retrospect is, that in these Highland districts we must be always prepared to meet with rock-masses of very different geological ages, thrown into puzzling juxtaposition by the gigantic movements to which this part of the earth's crust has been subjected. He who enters on the study of Highland geology without being prepared to encounter at every step complicated foldings, vast dislocations, and stupendous inversions of the strata, can scarcely fail to be betrayed into the most disastrous and fatal errors.

The early history of Scotland is inextricably interwoven with that of Scandinavia. This proposition, true as it is of the insignificant periods of which human history takes cognizance, applies with even greater force to the vast epochs that fall within the ken of the geologist. To us the separation of Scotland and Scandinavia is an event of very recent date indeed; it is not only an accident, but an uncompleted accident! The Scottish Highlands, with the Hebrides and Donegal on the one hand, with Orkney and Shetland on the other, must be regarded—to use a technical phrase—as mere "outliers" of the Scandinavian Peninsula.

We must acknowledge, at the outset, that the study of the geological history of this Scandinavian peninsula and its outliers is a task bristling with difficulties. The problems presented to us in our Scottish Highlands are vast, complicated, and at times seemingly insoluble. But they are precisely the same problems that confront our brother geologists in Scandinavia. And if our tasks, our doubts, our perplexities are the same, we equally share in the advantages and triumphs of discovery.

The geologists of Scandinavia—and right worthy sons of Thor they are—have the advantage of possessing a territory almost limitless in its vastness, and seemingly infinite in its variety. But the very extent of their splendid country, with its sparse population and restricted means of communication, increases the difficulties of their task. "The harvest truly is plenteous, but the labourers are few!" With our smaller area, if we cannot expect so much variety, we may hope to gain something from the number of our students and the greater accessibility of our fields of labour.

Nor would I undervalue, in this connection, the importance of the union of this country with England. I allude, of course, not to events of yesterday, like the Accession of James VI. to the English throne and the Parliamentary Act of Union, but to operations that preceded these by many millions of years! It is no small advantage that a country like Scotland, in which the rock-formations are found hopelessly crushed and crumpled together, or broken into a thousand illfitting fragments that seem to defy all attempts to reduce them to order, should be united to one like England, where, by comparison, all is orderly and simple, the strata lying in regular sequence like well-arranged volumes in a library, and only await the touch of the geologist's hammer to display the wealth of their fossil contents.

The great Scandinavian *massif*, with its outlying fragments, constitutes the "basal-wreck"—to employ Darwin's expressive term—of a great Alpine chain. On other occasions I have endeavoured to show how much our study of the nature and products of volcanic action is facilitated by the existence of similar "basal-wrecks" of volcanic mountains, like those which exist in your beautiful Western Isles. In the same way, I believe we may learn more by the study of this dissected mountain-chain, concerning the operations by which these grand features of our globe have originated, than by the most prolonged [illegible] of the superficial characters of the Alps or the [illegible].

[illegible] has laid bare the innermost [illegible] what we can only guess at [illegible] in our own High-[illegible] lofty moun-[illegible] period [illegible] the higher [illegible] work so rapidly that within a very short period—geologically speaking—the vastest mountain-chain is razed to its very foundations—

> "They melt like mists, the solid lands,
> Like clouds they shape themselves, and go!"

It is not surprising then to find Powell and Gilbert, fresh from the study of the grand mountain-masses of the American Continent, giving expression to these thoughts in the following words: "All large mountains are young mountains, and, from the point of view of the uniformitarian, it is equally evident that all large mountains must be growing mountains; for if the process of growth is continuous, and if a high mountain melts with exceptional rapidity before the play of the elements, it is illogical to suppose that the uprising of any mountain, which to-day is lofty, has to day ceased."

The Scandinavian Alps were a living and a growing mountain-chain in the far distant Palæozoic period. Now it is not only dead, but stretched on the dissecting table of the geologist—its outer integuments and softer tissues stripped away, and its very skeleton bared to our view—a splendid "subject" for the student of mountain anatomy.

One of the first to recognise this value of our Scottish Highlands to the student of Orographic Geology was the late Daniel Sharpe. He had made himself familiar with many of the characteristic details of Alpine architecture—so far as it was then understood—and was able to show that the foliated masses of our Highland districts exhibit precisely those relations which would be seen if the contorted and fan-like masses of the Alps were planed away by denudation. Nor in suggestions of this kind, as we have seen, was James Nicol far behind Sharpe; but at that time many of the most important features of mountain-structure were unrecognised or misinterpreted, and the conclusions of these geological pioneers were little more than guesses—though very valuable and suggestive guesses—after truth.

It is to our geological brethren over the Atlantic that we are especially indebted, not only for many important discoveries in the mechanics of mountain-formation, but for clearing away many of the clouds of error in which the subject had become involved. To Henry Darwin Rogers, who, after a career of valuable geological work in his native State of Pennsylvania, accepted the hospitality of this country, and spent the last decade of his useful life as Professor of Natural History and Geology in the sister university of Glasgow, must be assigned the foremost place in that school of orographic geologists which has grown up in America.

The first sketch of the important theory of mountain-building to which Rogers and his fellow-geologists were led by the study of the Appalachian chain, was published in 1842, but it was not till 1858 that the complete evidence on which this theory was founded could be published.

The conclusion at which Rogers arrived was, briefly expressed, as follows:—The Appalachian mountains were carved by denudation out of an enormously thick mass of stratified deposits, thrown into a series of parallel wave-like folds. To the westward of the mountain range "the crust-waves flatten out, recede from one another, and vanish into general horizontality;" but towards the heart of the mountain-mass the same flexed strata become greatly crowded together, their "axis-planes," become more and more inclined, till at last their folds, yielding at their apices to the tremendous lateral thrust, fractures twenty to eighty miles in length, and attended with a displacement of 20,000 feet or more, were produced.

Unfortunately Rogers accompanied these just views of mountain structure with certain crude speculations and untenable hypotheses concerning the methods by which they were produced. But in the minds of other American geologists, among whom may especially be mentioned Dana, Le Conte, and Vose—the fruitful ideas of Rogers have undergone development and expansion, while they have received abundant illustration through the labours of that active band of pioneers—the United States Geological Survey—including Clarence King, Powell, Emmons, Hague, Dutton, Gilbert, and many others.

Nor have the brilliant results attained by these investigators in the New World been without their effect on the geologists of Europe. Lory, Suess, Heim, Baltzer, and others have shown that the clue to the right understanding of the structure of the Alps, which had been so diligently sought and so long missed by Von Buch and De Beaumont, by Studer and Favre, was now placed in our hands by the researches of the American geologists.

In Northern Europe, Kjerulf, Dahll, Brøgger, Reusch, and other geologists have ably illustrated the same peculiarities of structure in the denuded mountain chain near the northern extremity of which we are now assembled; and in a recent valuable and suggestive essay "On the Secret of the Highlands" Professor Lapworth has shown how perfectly these structures are exemplified in the western district of Sutherland.

In offering a few remarks on some of the still unsolved problems of Highland geology I shall not hesitate to refer, as belonging to the same geological district, both Scandinavia and Scotland. Not only is the succession of geological deposits in the two areas almost completely identical, but the characters of the several formations and their relations to one another in the one country are almost the exact counterpart of what they are in the other.

The problems which await solution in Scotland are the same which confront our brethren in Scandinavia; their difficulties are our difficulties, their successes our successes; if they share the benefits of our discoveries, we equally partake with them in the fruits of their achievements. Certain links in the chain of geological evidence, accidentally wanting in the one area, may perchance be found in the other. Every advance, therefore, which is made in the knowledge of the rocks of the one country, must necessarily react upon the opinions and theories which prevail among geologists in the other.

At the base, and forming the foundation of this greatly denuded mountain chain, there exist enormous masses of highly foliated, crystalline rocks. These, in great part at least, are older than the oldest known fossiliferous strata, and are therefore of pre-Cambrian or Archæan age. In spite of the labours of Kjerulf, Dahll, Brøgger, Reusch, Törnebohm, and many others in Scandinavia, and of Murchison, Nicol, and their successors in this country, much still remains to be done in studying the petrographical characters and the geognostic relations of these widespread formations.

Some thirty years ago it was suggested by Sir Roderick Murchison that among these Archæan rocks there exists a "fundamental gneiss," a formation which is the counterpart and contemporary of the rocks in Canada, to which Sir William Logan gave the name of "Laurentian." Since that time other similar attempts have been made to identify portions of these Archæan rocks in the Highlands and Scandinavia with crystalline rock masses in different parts of the New and Old World.

I confess that, speaking for myself, I am not sanguine as to the success of such endeavours. The miserable failures which we have seen to have attended similar attempts, in the case of far less altered rocks, where identifications have been based on mineralogical resemblances only, or in connection with which definite palæontological or stratigraphical evidence has been subsequently obtained, ought surely to teach us caution in generalising from such uncertain data. It has been argued that, where palæontological evidence is wholly wanting, and stratigraphical relations are doubtful or obscure, then we may be allowed [illegible] the only [illegible] remaining to us [illegible] those derived from [illegible] resemblances. But surely in such cases it is wiser to [illegible] the insufficiency of the evidence and to say "We do not know," rather than to [illegible] a [illegible] with a store of petrological [illegible] bearing the broad arrow [illegible] of a certain terrestrial age. The [illegible] may [illegible] with [illegible] that

[illegible]

It is thought by some that the [illegible] of the microscope [illegible] study of rock masses may reveal peculiarities of structure that will serve as a substitute for palæontological evidence concerning the age of a rock when the latter is wanting. Greatly as I value the insight afforded to us by the microscope when it is applied to the study of the rocks, and highly as I esteem the opinions of some of those who hold these views, yet I fail to see that any such connection between the minute structure and the geological age of a rock has as yet been established.

Although the bold generalisation which sought to sweep all the crystalline rocks of our central Highlands into the great Silurian net has admittedly broken down, yet it by no means follows that the whole of these rock masses are of Archæan age. Nicol always held that among the crystalline foldings of the Highland rocks many portions of the older Palæozoic formations, in a highly altered condition, were included (see Quart. Jour. Geol. Soc., vol. xix. (1863), p. 184, and "Geology and Scenery of the North of Scotland," 1866). The same view has been persistently maintained by Dr. Hicks, to whose researches on the most ancient rock-masses of the British Isles geologists are so greatly indebted, and also by Prof. Lapworth.

To the settlement of this very important question we are sure that the efforts of the officers of the Geological Survey will be especially directed. The geological surveyors of Sweden have been so fortunate as to detect, in rocks of an almost [illegible] altered character, a number of fossils sufficiently well preserved for generic and sometimes even for specific determination. [illegible] ing the occurrence of such a fortunate accident, I confess that it has always appeared to me that the disturbances to which the Highland rocks have been subjected are so extreme, and the difficulty of making out the original planes of bedding so great, that but little can be hoped for from general sections intended to show the relations of the rocks of the Central and Western Grampians to the fossiliferous deposits of the North-West of Sutherland.

Lying unconformably upon these Archæan crystalline rocks in the North West Highlands we find great masses of coarse felspathic grit, with some conglomerates, the whole of these well-stratified deposits attaining a thickness of several thousands of feet. These rocks, in their characters and their relations, so greatly resemble the "Sparagmite Formation" of Scandinavia that it is impossible to refrain from drawing comparisons between them. The Scandinavian formation, however, includes [illegible] and [illegible] deposits, which are wanting in its Scottish [illegible]. The "Sparagmites" of Scandinavia, as a whole, [illegible] underlie strata containing Cambrian (Primordial) fossils, [illegible] the very highest portion of the "Upper Sparagmite Formation" of Southern Norway there have been found, according to [illegible], specimens of *Paradoxides*.

The Scottish formation has, on the other hand, [illegible] undoubted organic remains. Murchison, on the ground of its [illegible] unconformable infraposition to his Silurian strata, and [illegible] likeness to certain beds in Wales which he called Cambrian, referred it in his later years to that system. Although [illegible] on such grounds, must be admitted to be of [illegible] value [illegible], yet the discovery of "Primordial" fossils in the very similar rocks of Scandinavia may be admitted to lend some weight [illegible] support. In the present state of our knowledge, however, it is surely wiser to admit that the question of the age of these beds is still an open one, and to call it by the name suggested by Nicol—"The Torridon Sandstone." [illegible] there is [illegible] evidence that the Scandinavian Sparagmite, in places, passes horizontally into true gneiss, and similar [illegible] may not be wanting in the case of our Torridon Sandstone.

(*To be continued.*)

## *NOTES FOR THE OPENING OF A DISCUSSION ON ELECTROLYSIS, TO BE HELD IN SECTION B, AT THE BRITISH ASSOCIATION IN ABERDEEN, SEPT., 1885, BY PROFESSOR OLIVER LODGE*

1. WHAT is an *Electrolyte?* The question has two distinct meanings:

(a) Is a given substance an electrolyte at all; i.e. when alone.

(b) Is it the electrolyte in any particular case; i.e. when mixed with other substances.

In answering (a) remember that the fact of bad conducting does not imply that what there is is a non-electrolyte. [illegible] electrolyte is one whose conduction is wholly electrolytic. Distinction between metallic and electrolytic conduction. Obedience to Ohm's law shown by electrolytes.

*Tests of Electrolytic conduction.*
1. Visible decomposition.
2. Polarisation.
3. Non agreement with Volta's series-law.
4. Transparency.

In answering (b) the fact of bad conductivity gives a decided negative, but substances which almost insulate when alone may conduct when mixed; *e.g.* $H_2O$ + HCl.

To the question, What is the real conductor when a salt (or acid) is dissolved in water? there are four possible answers

combination. Such facts as these, if well established, render necessary *some form* of dissociation hypothesis.

A Grotthus chain of quite *equidistant* atoms might serve, instead of actual dissociation, or a momentary dissociation would be sufficient; but no hypothesis which involves a *lasting* overstrain of molecules in the *interior* of a homogeneous electrolyte can be permitted.

Herein lies the great distinction between electrolytes and dielectrics.

Hypotheses (1) and (2) may be held in either of two forms:—

(*a*) The electrical influence of the electrodes may be supposed to reach every molecule of the fluid. This was Grotthus's form of (1), and is Quincke's form of (2).

(*b*) The electrical influence of each electrode may only extend within molecular distance of its surface, while the adjustments occurring in the main body of the fluid are effected by ordinary diffusion. This was probably Faraday's form of (1), and it is Maxwell's form of (2).

Helmholtz's hypothesis (3) emphasises the (*b*) aspect of the matter by appealing to electrostatic interactions of the atoms to maintain uniformity of composition. And within a range of $10^{-8}$ centimetres of each electrode there is supposed to exist an ordinary electrostatic strain, like that in an ordinary dielectric condenser plate.

The great magnitude of the atomic charges explains the feebleness of the difference of potential required to effect decomposition on electrostatic principles. And the same thing suggests a mainly electrical theory of chemical affinity.

To separate an atom from its charge requires expenditure of work, hence Helmholtz's theory of a specific attraction between matter and electricity, which he uses to explain Volta's "contact force," the charge of atoms in a molecule, frictional electricity, and many other phenomena.

VI.—*Addenda*

Calculation of EMF needed to effect decomposition—

(*a*) of a dielectric,

(*b*) of an electrolyte,

on electrostatic principles.

Suggested theory of disruptive discharge.

Possible distinction between chemical compounds and molecular aggregates.

Discussion of various phenomena from the point of view of a possible "atomic" theory of electricity.

## NOTES

SINCE our last issue Dr. Hartwig, of the Dorpat Observatory, has announced an apparent variation in the great nebula of Andromeda, which has caused some excitement in the astronomical world. As represented in all our drawings, and, still better, in a photograph which Mr. Common was fortunate enough to obtain last year, the centre of the nebula appeared to be only moderately condensed. There was no star or stellar point. Now, on the contrary, there is a most unmistakable star of the eighth or ninth magnitude. The question is, is this a stellar mass in the line of sight of the nebula, or has the phenomenon been produced by a new condensation in the centre of the nebula itself? Opinion inclines to the latter view, as, according to some accounts, other accompanying changes have been seen with large instruments, &c. But, on the other hand, spectroscopic evidence that the apparent nebula is not a very distant cluster is absent. By our next issue we may hope for a large harvest of telescopic and spectroscopic observations of this new object.

THE International Congress of Schoolmasters was opened in the Grand Theatre at Havre on the afternoon of the 6th instant, Mr. Goblet, the Minister of Public Instruction, presiding.

THE Severn tunnel has now been completed, and on Saturday last a train containing officials and their friends passed through it from end to end.

A CASE of Asiatic cholera has occurred at Cardiff. A labourer, loading a vessel which had recently arrived from Barcelona, drank water which had been put into a cask at that port, and which was described by the medical inspector as totally unfit to drink, having the appearance of diluted milk, and being putrid. The man died in a few hours of Asiatic cholera.

ON August 25 and subsequent days was held in [illegible] International Congress of Alpine Clubs. The principal [illegible] discussion was the better management of refuges [illegible] different parts of the Alps, new regulations for guides, [illegible] pensions to be granted to them. The honorary president [illegible] the King of Italy, His Majesty being represented by [illegible] the acting president was Prof. Ferrati. The readings of [illegible] mum and maximum thermometers were also collected and [illegible] cussed. Several excursions took place at the close of the session.

THE German Meteorological Society met for the [illegible] at Munich last month. Prof. Bezold, of Munich, who delivered the address of the meeting, took for his subject "The [illegible] of Meteorology during the last Ten Years," dwelling [illegible] the alterations made by the introduction of the synoptical [illegible] in connection with telegraphy.

THE eleventh *Bulletin* of the United States Geological [illegible] is a paper on the quaternary and recent mollusca of the [illegible] Basin, with descriptions of new forms, by Mr. R. Ellsworth Call, with an introduction containing a sketch of the quaternary lakes of the Great Basin, by Mr. G. K. Gilbert.

REPEATED severe shocks of earthquake have occurred in the south-east of Lower Austria and in the north of Styria, and have been followed by further shocks in Bosnia, described as moving from east to west.

WE have received Prof. Holden's account of the progress of astronomy in 1884, and Prof. Rockwood's account of volcanology and seismology for the years 1883 and 1884, reprinted from the Smithsonian Report for 1884; also Mr. Albert Williams's [illegible] on placer mines, and mining districts, from the [illegible] tenth census of the United States on the statistics and [illegible] of the precious metals.

THE programme of the technological examinations of the City and Guilds of London Institute for the Advancement of Technical Education for the session 1885–86 has been published. It contains a detailed syllabus of the examinations for the different grades on each subject, and copies of recent examination papers. It is to be obtained at the offices at Gresham College, and Exhibition Road.

MR. G. J. SYMONS, who has examined the trees recently damaged by lightning in Richmond Park, has communicated the results of his observations to the *Times*. They are two of a group of oaks in the eastern part of the park, slightly south-east of, but very near, the White Lodge. They were fine ones, their girth at 3 feet being 11 and 12 feet respectively; the trees are 25 feet apart, and one is nearly due north of the other. There are three other trees quite close to them, within 40 feet, which are uninjured, except by the branches which were thrown upon them. The injury to one tree, though fatal to it, is not important, but the other tree affords a tremendous instance of disruptive power. It appears to have been cut through horizontally at about 3 feet above the ground; the upper portion shows comparatively little injury, but the lower part is not merely stripped of its bark, but burst open in a very [illegible] spikes of the stem, several inches thick and 10 to 15 feet long, stand out from the trunk somewhat like the ribs of an umbrella before it is fully opened, and gaps between themselves and the centre of the trunk branches which fell from the upper part before they had time to reclose, while the ground for perhaps 200 feet around is strewn with the bark and fragments of

Ireland. He also compiled an account of the measurement of the Loch Foyle base, which was made during the years 1827–29. The article on geodesy, which forms part of the mathematical text-book used at the Royal Military College, was written by Col. Yolland. In 1854 Col. Yolland was appointed one of the Inspectors of Railways under the Board of Trade. In 1856 he was selected as the engineer member of the Commission appointed by the Secretary of State for War to consider the best mode of reorganising the system of training officers of the scientific corps, with the special intention of abolishing patronage and opening the commissions in those corps to competition. The Commissioners, the other two of whom were Col. W. J. Smith, R.A., and the Rev. W. [illegible] Lake, visited France, Prussia, Austria, and Sardinia, and after studying the methods of appointment in use in those countries, drew up a report, which was printed by order of the House of Commons.

Dr. Schomburgk's Report on the Progress and Condition of the Botanic Garden and Government Plantations in South Australia for the year 1884, which is dated from the Botanic Garden, Adelaide, in March last, gives as usual, a [illegible] of interesting matter on the cultivation of useful plants. The [illegible] operation, which has of late years been so much extended between the botanic gardens in all [illegible] colonial and foreign [illegible] sections, has been the means of [illegible] the [illegible] increased energy in the development of new resources and the interchange of valuable plants, [illegible] that matter of a similar character, or treating of the same [illegible], often appear in reports from gardens widely separated geographically from each other. Thus we find in the report before [illegible] on the suitability or otherwise for Australian cultivation of many plants that have been similarly reported on from other parts of the world. Among those reported upon by Dr. Schomburgk may be mentioned mustard, rape, sesamum, ground [illegible], tobacco, [illegible] seed, chicory, [illegible], [illegible], [illegible] [illegible] grass (Macrochloa tenacissima) [illegible] Spain, Portugal, and North Africa, and [illegible] are imported into England alone to the amount of 140,000 to 150,000 tons [illegible] year, [illegible] that it is becoming scarcer every day, and consequently fetching higher prices. Dr. Schomburgk says: "Considering the similarity of our climate with that of Spain I endeavoured to introduce this valuable grass into the Colony, which, after many difficulties, I succeeded in accomplishing, and I have not been disappointed in its acclimatisation in South Australia. The grass which I have now cultivated for the last five years grows luxuriantly with us, notwithstanding the most [illegible] droughts we have to contend with. It is propagated [illegible] seed. The question will naturally be asked, 'Suppose we succeed in growing the grass here, where shall we find a market for it?' The enterprising and go-ahead neighbours in Victoria have recently established two paper mills, and I understand they also possess one, so that, if we succeed, the market [illegible] the grass is close at hand, and it [illegible] would even pay [illegible] the grass to England, as the means of hydraulic pressure the [illegible] would be considerably reduced." Another industry which seems to promise well in South Australia is the production of sumac, which consists of the powdered leaves and twigs of [illegible] and Rhus [illegible] shrubs of the Mediterranean region, and grown largely in Southern Europe for the sake of the leaves. Dr. Schomburgk says that plants grown in the Adelaide Botanic Garden, and the climate seems to suit them; he recommends, however, that trials should be made to ascertain whether they would thrive in poor or sandy soil. On this subject the British Consul at Palermo, in the neighbourhood of which the best sumac is grown, says the soil best adapted for the plant is that of a sandy nature. It is propagated by cuttings. The bulk of the sumac is shipped from Palermo to various countries, but principally to the United States. A catalogue of plants added during 1884 to the collection under cultivation at the Botanic Garden is given in the form of an appendix.

It was hardly to be expected that the season should pass without the appearance of the sea-serpent somewhere, and if we are to believe the information forwarded to us from a correspondent in Norway, it has just visited the coast of Nordland. Three Sundays ago some lads were returning to the island of [illegible] from the church at Melø, in the middle of the day, when they saw far out in the fjord a streak in the sea, which they believed to be a flock of wild ducks swimming. On [illegible], however, they heard the whizzing as of a rushing [illegible], in a few moments perceived a great sea-monster with [illegible] velocity making straight for the boat. It appeared to be serpentine in shape, with a flat, scaly head, and the lads count seventeen coils on the surface of the water just as it passed the stern of the boat so closely that they could have thrown [illegible] it. By subsequent measurements on land the length of the animal was estimated at about 200 feet. It pursued its course on the surface of the sea until close behind the [illegible], when it went down with a tremendous noise, but reappeared a little after, shaping its course for the Melø, where it disappeared from view. Naturally the lads were greatly frightened. The weather at the time was hot, calm, and sunny. Our informant [illegible] that the lads are intelligent and truthful, and that there [illegible] no reason to discredit their unanimous statement, made, as they were, in a terribly frightened condition. It might be added that the waters in which the animal was seen are some of the deepest on the Norwegian coast, and that it is not the first time [illegible] men have averred having seen the sea-serpent here. The existence of the sea-serpent is fully believed in along the coast of Norway.

We have received the *Journal and Proceedings* (vol. [illegible]) of the Royal Society of New South Wales for 1884. Besides the President's address, it contains several papers, reports of the various meetings, an abstract of the meteorological observations at the Sydney Observatory, and a rainfall map. Amongst the papers we find one on the removal of bars from the mouths of rivers, by Mr. Shellshear; on some New South Wales [illegible], by Prof. Liversidge; on the oven-mounds of the aborigines of Victoria, by Mr. MacPherson; on a new form of [illegible], by Mr. Russell; on the water supply of the interior of New South Wales; and shorter papers on gold, on the [illegible] plant, on [illegible], &c., Mr. Caldwell's paper on the embryology of the marsupials, monotremata, and ceratodus.

We have to acknowledge a copy of the English translation of the paper read by Messrs. Thorell and Lindström to the Royal Swedish Academy of Sciences, on the Silurian scorpion found in Gottland (NATURE, vol. xxxi. p. 295). It is published by Norstedt and Sons, Stockholm.

The ceremony of the Chevreul centenary has been postponed until January 1, 1886. To give more solemnity to the solemnity, all the Paris students will be present at the *fête*, [illegible] of them are in the provinces or abroad. The health of M. Chevreul continues excellent, and the delay is not likely to prove an obstacle to the ceremony.

Prof. Doolittle, of the Lehigh University, Pennsylvania, has published a treatise on practical astronomy, as applied to geodesy and navigation (New York: Wiley; London: Trübner). It is intended as a text-book for universities and technical schools, and as a manual for the field astronomer. The object has been to present in a systematic form the most approved methods in use at the present time, and these are illustrated by complete numerical examples. In the introduction the method of least squares is developed with special reference to the requirements of this particular class of work.

## ASTRONOMICAL PHENOMENA FOR THE WEEK 1885, SEPTEMBER [illegible]

## ASTRONOMICAL NOTES

NEW COMET.—A new comet, discovered by Mr. Brooks, has been observed by Mr. Wendell, of Harvard College Observatory, and Mr. Ainslie Common, of Ealing. On Friday night its approximate position was R.A. 13h. 53m., and N.P.D. 52° 20′. Its R.A. is increasing and N.P.D. decreasing; diameter, 9 minutes of arc, and getting brighter.

NEW MINOR PLANET.—On the evening of the 3rd inst. Herr Palisa, of Vienna, discovered a minor planet, thus bringing the number of these bodies to 250. The following are the particulars of the discovery:—September 3, 9h. 53s. (Greenwich mean time); right ascension, 23h. 34m. 44s.; north polar distance, 106° 9′ 35″; daily motion in right ascension, 48s. decreasing, in polar distance 3′ increasing; magnitude, 11th.

## GEOGRAPHICAL NOTES

THE Caroline Islands, which are attracting so much political attention now, are described at some length in the *Gazette Géographique*. It is generally acknowledged that they were discovered by a Portuguese navigator in 1526, and during the rest of the sixteenth century they were frequently visited by Spanish and Portuguese explorers. They were called the Carolines about 1686 by a pilot named Lezcano, who saw many islets there, but could not tell to what group they belonged, or indicate their exact position. The name was given to them after Charles II.; they have also been called the New Philippines, but this has never prevailed. Towards the end of the seventeenth century the Spaniards in the Philippines and Mariannes learned something of the Carolines, and in 1705 an imperfect map of the group was sent to Pope Clement XI., and then the Jesuits of the mission at Manila resolved to establish a branch in the Carolines. In 1710 the missionaries and a few soldiers set sail, but on arriving at the Pelews were all massacred. Up to 1817 the Carolines were visited by navigators of all nations, but the number of the islands, their exact position, and the hydrography of the seas in which they were situated, was totally unknown. In that year Kotzebue, and subsequently Freycinet, Duperrey, Dumont d'Urville, and others, visited the whole of the Archipelago, and from them we got our first accurate accounts of the Carolines and their inhabitants. The Caroline archipelago forms part of Micronesia, and is situated to the south of the Ladrones, to the west of the Marshalls, and to the north of New Guinea. It consists of about 500 islands, of which the greater number are only *atolls*. The number of real islands is only forty-eight, but as each of these is surrounded by a certain number of islets, it may be said that the archipelago consists of forty-eight groups; forty-three of these are low coral islands, while five are composed of basalt with coral at the base. The superficial area over which the archipelago is spread is about forty-five square leagues. Geographically it may be divided into three main groups, separated by two large channels: the eastern group, of which the principal island is Ascension or Ponape; the central group, and the western group, the principal island being Eap or Jap, of which much is being heard just now. Ponape is between 50 and 60 miles round, and has a peak in the centre which rises to a height of 2860 feet. At one part of its coast there are curious ruins which are still a problem for ethnologists; they are apparently the remains of a large building constructed of huge blocks of basalt. The archipelago, although close to the equator, enjoys a temperate climate; there are two rainy seasons—one in January, the other in August. The islands are of astonishing fertility; the principal productions are the bread-fruit, cocoa-nut, the palm, bamboo, orange, and clove tree, sugar-cane, beetle, sweet potato, &c. The population is generally estimated at 18,000 to 20,000, and belongs ethnologically to the Micronesian family. The principal elements are Malay and Maori; but there is also a mixture of Negrito and Papuan, to which in later times was added a Chinese and Japanese element. The language is as mixed as the race; the grammatical constructions are the same as those of the Maori, but Malay influence is also evident. In some of the islands there are two languages, as in Java—the vulgar and polished. They have no religion properly so-called; they believe in spirits, which are the souls of their deceased ancestors, and they have a great respect, a kind of cult for their dead, whom they preserve till the body falls to pieces. As in all the islands of the Pacific, is practised. Each group of islands is governed by a chief king. His power in time of peace is purely nominal, but he enjoys the respect of all; but in the frequent bloody wars his authority is unbounded, and all submit blindly to his will.

THE Pelews or Palaos Islands are quite distinct from the Carolines; they are the most western islands of Micronesia, and are situated about 600 miles east of the Philippines. The archipelago consists of ten principal islands and a number of islets. The principal one, called Babelthuap, is 30 miles long, the southern part being very mountainous. All the islands are covered with thick forests, the trees of which are used by the natives to construct their large canoes. Besides the yam and the cocoa-nut, there are also bananas, oranges, and a large number of nutritious roots. The population is about 3500 souls, belonging to a race which is quite distinct from the Caroline Islanders. They present all the characteristics of the Malay and Papuan races, and are probably the result of the mixture of a superior Malay race with an inferior aboriginal people. Old travellers speak very well of these natives: they are said to be in every way superior to the inhabitants of the Caroline Islands. Here also there are two languages: one for addressing superiors, the other inferiors; possibly it would be more correct to say that there is only one language, with copious honorific forms. The king has instituted an order, which he gives or withdraws at his pleasure; the insignia is the first cervical vertebra of the fish *dugong*.

THE *Rundschau fur Geographie und Statistik* for September reproduces a forgotten discourse of Alexander von Humboldt. It was never published, although it was privately printed for the use of the members of the Society before whom it was delivered. It deals with the primitive peoples of America and the monuments which they have left behind them, and was delivered before the Philomatic Society of Berlin in January, 1806; that is, a few months after his return from his travels. It had grown to be a bibliographical curiosity; part of its contents was afterwards reproduced in his "Ansichten der Natur" and "Vues des Cordillères," and later investigations have materially altered some positions taken up; but the discourse is otherwise very interesting, especially after its disappearance for nearly eighty years.

## CONTENTS

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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. 829, Vol. 32] THURSDAY, SEPTEMBER 17, 1885 [Price Sixpence

Registered as a Newspaper at the General Post Office]

## CITY AND GUILDS OF LONDON INSTITUTE

FOR THE ADVANCEMENT OF TECHNICAL EDUCATION
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Vice-Presidents:
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## CITY AND GUILDS OF LONDON INSTITUTE.

CENTRAL INSTITUTION, EXHIBITION ROAD, S.W.

Course of Technical Instruction for Engineers, Manufacturers, and [illegible] under the direction of Prof. Henrici, LL.D., F.R.S., Prof. [illegible], M.Inst.C.E., Prof. Ayrton, F.R.S., and Prof. Armstrong, Ph.D., F.R.S.

The Clothworkers' Scholarship of £60 for three years, the [illegible] Memorial Scholarship of £[illegible] for three years, and two Mitchell Scholarships of £30 for two years, one with free education, will be awarded on the results of the Entrance or Matriculation Examination, to be held on TUESDAY, September [illegible], and on the three following days.

The SESSION COMMENCES on TUESDAY, October 6.

For further particulars, and for the programme of instruction, apply at Exhibition Road, S.W., or at Finsbury College, E.C.

## CITY AND GUILDS OF LONDON INSTITUTE.

FINSBURY TECHNICAL COLLEGE.

DAY DEPARTMENT for Students not under 14 years of age.

The College Courses provide Technical Instruction for Mechanical and Electrical Engineers, Technical Chemists, Builders, and Cabinet Makers. [illegible] for the Session, inclusive of Laboratories and Workshops, £[illegible]. Two Saddlers' Company Studentships of £[illegible] for two years, two [illegible] Scholarships of £[illegible] for two years, and the [illegible] Scholarship of £[illegible] for two years (with Free Education) will be awarded on the result of the Entrance Examination which will take place on THURSDAY, October 1, at [illegible].

The SESSION COMMENCES on Monday, October 5.

For further particulars apply at the College, Leonard Street, City Road, E.C., or at Finsbury College, E.C.

## CITY AND GUILDS OF LONDON INSTITUTE.

FINSBURY TECHNICAL COLLEGE.

EVENING DEPARTMENT for Apprentices, Journeymen, Foremen, and others. Instruction in Mechanical and Electrical Engineering, Technical Chemistry, Applied Art, Cabinet making, Metal Plate work, Builders' and Plumbers' Work, Carpentry and Joinery, Bricklaying, &c.

Fees from [illegible] for the Session, inclusive of Laboratories and Workshops.

Apprentices are admitted at half the ordinary fees.

For further particulars apply at the College, Leonard Street, City Road, [illegible] or at Finsbury College, E.C.

## CITY AND GUILDS OF LONDON INSTITUTE.

SOUTH LONDON SCHOOL OF TECHNICAL ART,
[illegible], Kennington Park Road, S.E.

Classes in Modelling, Design, Drawing and Painting from Life. Wood Engraving, [illegible] Painting, and Art Metal Work. Commencing on TUESDAY, October 6.

For further particulars apply at [illegible], Kennington Park Road, S.E., or at [illegible] College, E.C.

## CITY AND GUILDS OF LONDON INSTITUTE.

TECHNOLOGICAL EXAMINATIONS.

The NEXT EXAMINATION will be held on May [illegible]. Teachers desiring to form Classes should apply at once to the Director at the Offices of the Institute, Gresham College, [illegible], or Exhibition Road, S.W., from whom particulars of all branches of the Institute's work may be obtained.

PHILIP MAGNUS, Director and Secretary.

## UNIVERSITY COLLEGE, LONDON.

The Session of the Faculty of Medicine will commence on OCTOBER 1. Introductory Lecture at 4 p.m. by Prof. [illegible], F.R.S.

The Examinations for the Entrance Exhibitions will be holden SEPTEMBER [illegible].

Scholarships, Exhibitions, and Prizes of the Value of £[illegible] are awarded Annually.

In University College Hospital over [illegible] In-patients and [illegible] Out-patients are treated during the year. Thirty-six Appointments, eighteen being resident, as House Surgeons, House Physicians, and [illegible] Assistant, &c., are filled up by competition during the year, and these, as well as all Clerkships and Dresserships, are open to Students of the Hospital without extra Fee.

Prospectuses, with full information as to Classes, Prizes, &c., may be obtained from the College, Gower Street, W.C.

G. V. POORE, M.D., Dean of the Faculty.
TALFOURD ELY, M.A., Secretary.

## LIVING SPECIMENS FOR THE MICROSCOPE

GOLD MEDAL awarded at the FISHERIES EXHIBITION [illegible]

THOMAS BOLTON, 57, NEWHALL STREET, BIRMINGHAM,

who has last week sent to his subscribers [illegible] drawing and description. He has also sent out [illegible] Alcyonella fungosa, Plumatella repens, [illegible] socialis, Lepidurus lyallus, Spongilla, Volvox globator, [illegible] Amoeba, Vorticella, Crayfish, and other Specimens for [illegible] Biological Laboratory work.

Weekly Announcements will be made in this place of Organisms [illegible] supplying.

**Specimen Tube, One Shilling, post free.**

*Twenty-six Tubes in course of Six Months for Subscription [illegible] or Twelve Tubes for [illegible]*

Portfolio of Drawings, Eleven Parts, [illegible]

## THE MIDDLESEX HOSPITAL

The WINTER SESSION will open on THURSDAY [illegible] an Introductory Address by Dr. J. K. FOWLER, M.A.

The Medical School, which has lately been considerably enlarged [illegible] the most complete means for the education of Students [illegible] University of London, the Colleges of Physicians and Surgeons [illegible] Licensing Bodies. Two Entrance Scholarships of the annual [illegible] and £[illegible] tenable for two years, and an Entrance [illegible] £[illegible], will be competed for on SEPTEMBER [illegible] and following days [illegible] arrangements are made for the convenience of Dental Students [illegible] information may be obtained from the Dean or the Resident [illegible] at the Hospital.

ANDREW CLARK, [illegible]

## ST. THOMAS'S HOSPITAL MEDICAL SCHOOL.

ALBERT EMBANKMENT, LONDON, S.E.

The WINTER SESSION of 1885-86 will commence on [illegible] when an Introductory Address will be delivered by A. G. [illegible] Esq., M.C.[illegible], at 3 p.m.

TWO ENTRANCE SCIENCE SCHOLARSHIPS of [illegible] respectively, open to all first-year Students, will be offered [illegible] The Examination will be held on the 5th, 6th, and 7th of [illegible] subjects will be [illegible] and Physics, with other [illegible] the option of Candidates.

Special Classes are held throughout the year for the "PRELIMINARY SCIENTIFIC" and "INTERMEDIATE M.B." Examinations of the UNIVERSITY of LONDON.

All Hospital Appointments are open to Students without extra fee. [illegible] Prizes of considerable value are awarded [illegible] as also several Medals.

The Fees may be paid in one sum or by instalments. [illegible] made to Lectures [illegible] to Hospital Practice, and special arrangements made for Students entering in their second or subsequent year [illegible] Dental Students and [illegible] Qualified Practitioners.

Several [illegible] and private families receive [illegible] for residence and supervision, and a register [illegible] in the Secretary's office.

Prospectuses and all particulars may be obtained from the [illegible] Mr. [illegible]

W. M. ORD, Dean.

## ST. GEORGE'S HOSPITAL MEDICAL SCHOOL.

HYDE PARK CORNER, S.W.

The WINTER SESSION will commence on THURSDAY, October [illegible] with an Introductory Address by TIMOTHY HOLMES, Esq., F.R.C.S., at 4 p.m. A Prospectus of the School and further information may be obtained by personal application between 1 and 3 p.m., or by letter addressed to the Dean at the Hospital.

## ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

AGRICULTURAL EDUCATION [illegible]

The Examination [illegible] LAR [illegible] will take place [illegible] from which Pupils are [illegible] NOVEMBER [illegible]

[illegible] may be had on application to H. M. JENKINS, Secretary, [illegible] Hanover Square, London, W.

## THE MASON SCIENCE COLLEGE BIRMINGHAM

SCHOLARSHIP IN CHEMISTRY OF £[illegible] PER ANNUM

An Examination for the Scholarship will be held early in October [illegible] have studied Chemistry two years in the College [illegible] may be B.Sc. of London, or Associates of the Institute of Chemistry. Applications to be made before October [illegible]

GEO. H. MORLEY, Secretary.

## BOOKS (Secondhand), Miscellaneous, &c.

[illegible] — C. HERBERT, English and Foreign Bookseller, [illegible] Goswell Road, London, E.C. Catalogues free [illegible] Libraries, Old Books, and Parchment purchased.

## *[...] IN ANDROMEDA*

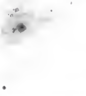
ollowing important commun[...] rd Rosse and Dr. Huggins [...] Whether the star be connected [...] ng the last week evidence has [...] at it has changed both in [...] regard to the nucleus. This [...] tion is of the highest import[...] advanced in this journal [...] on the occasion of the [...] which suggested that a body [...] rapidly could have no very great [...] might not be so very remote. [...] doubt between the different [...] published as to the spectrum [...] doubt as to the existence of [...] This endorses Lord [...] re printed last week.

[illegible]

1866, October [illegible]

[illegible]

[illegible]



[illegible]

stellar point situated near the central region of the nebula. It is quite free from any blurred appearance or any aspect of indefiniteness other than that introduced by the nebula on which it is projected.

On later nights the star seemed to have slightly decreased; its light was feebler and less sparkling, but I made no exact comparisons for tracing the decline of brilliancy, if any.

During many years the naked eye appearance of this conspicuous nebula has been familiar to me, and I have been accustomed to notice it particularly while engaged in prolonged watches for shooting stars. No sharply-defined nucleus was ever perceptible, but now the involved star is distinctly visible by slightly averting the vision. When the air is very clear the glowing out of the star now and then is very obvious, and I mention the fact in proof that the variation of the nebula by this new phenomenon is sufficiently great to affect its naked-eye aspect. W. F. DENNING

Bristol, September 13

## 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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### Red Rays after Sunset

THERE have lately been seen here some remarkable examples of rose-coloured streamers radiating from the sun at an interval of from 20 to 30 minutes after sunset, particularly on the 3rd, 5th, and 6th of this month. On the 3rd the appearance was especially striking, the contrast of colour between one very broad, vertical ray and the greenish-gray sky which separated it from its neighbours being most marked.

That these rose-coloured rays are essentially identical with the diffused rose-tint observed on other occasions is evident, not only from the similarity of colour and of interval after sunset at which they appear, but also from the occurrence of intermediate examples, in which the rays are so far and so broad that the radiate character is almost lost.

It is, however, by no means so clear why the coloured tract of sky should be sometimes split into rays, and it is with a view to ventilate this question that I desire to call attention to the subject.

I believe it is generally supposed that the dark spaces between the rays are due to masses of cloud intercepting the sun's light, but there are difficulties in the way of this explanation which I have never seen met.

It need hardly be pointed out that the matter (whatever it be) which reflects the red light must be at an altitude far above any such masses of cloud as could intercept the sun's rays; it could not otherwise receive and reflect those rays half an hour after the sun had set to the observer. But although above the level of the clouds, the reflecting matter would still be subject to interception of the sun's rays by cloud at sunset, and in order to judge whether the phenomenon can be so accounted for it is necessary to consider what kind of horizon that would be behind which the sun would set to an observer at the altitude supposed. My impression is that the horizon as seen from such a height would be so distant that whatever the irregularities of cloud-surface forming it, it would be practically a level line, and that the most mountainous masses of cumulus-cloud would be insufficient to cast at that distance the enormous shadows which would be necessary to account for the rifts between the ra[ys].

Clifton, September 8 GEORGE F. BU[illegible]

### Fireball

A LARGE fireball was visible at Bristol and other plac[illegible] September 11, at about 9h. 25m. p.m. It was described to [illegible] by several observers who approximately assigned its path as fr[illegible] *Altair* towards the western horizon. The sky was much clouded here at the time, with only 1st magnitude stars visible, but the light of the meteor appears to have been something astonishing.

Mr. G. T. Davis, of Theale, near Reading, writes me that, when first seen there, the meteor was near β Ophiuchi, and seemed to describe a slightly curved path to the horizon, which it touched apparently under β Serpentis. It exhibited a greenish tinted disk with bright, white aureole around it, and left no train. The aureole was at least 16′ in diameter.

It will be desirable to collect further accounts of this fine meteor. The direction of its path suggests that it may belong to the same system as that of the detonating fireball of September 14, 1875, which had a radiant point at $\alpha$ 348°, $\delta$ 0° ± (Tupman). During the past fortnight I have observed a considerable number of shooting-stars, and one of the best radiant points is at $\alpha$ 346, $\delta$ 0° ±, or 2° W. of that of Col. Tupman's fireball of September 14, 1875. W. F. DENNING

Bristol, September 13

### Pulsation in the Veins

IF Mr. Hippisley will refer to Landois' text-book, vol. [illegible] p. 196, he will find it there stated, on the authority of Quincke, that a venous pulse occurs on rare occasions, normally, in the veins on the back of the hand and foot, when the peripheral ends of the arteries become dilated and relaxed. But it is to be remembered that the very same phenomenon may occur *abnormally*, owing to some pathological condition of the heart, as stenosis of the mitral orifice, or insufficiency in action of the mitral valve. Mr. Hippisley does not state in his letter whether the heart was in a healthy condition, or whether any lesion of that organ was present in those on whom his experiments were tried. J. W. WILLIAMS

Middlesex Hospital

### "Furculum" or "Furcula"

Is there any authority for the use of furcu*lum* for the *furculatorium* of birds? I am told by a contributor to the *Proceedings* of this Society, whose phraseology I have no wish to interfere with, that "furcu*lum*" has been employed by Balfour, Huxley, and Rolleston. Such may be the case, but it is possible that even these great anatomical writers may have erred in the use of a Latin termination. No dictionary that I have been able to refer to contains the word "furculum."

The Zoological Society of London P. L. SCLATER

## THE BRITISH ASSOCIATION

*Aberdeen, Monday*

THERE have been few meetings of the British Association so crowded with papers in nearly all the sections. On Saturday several sections met which, under the greatest pressure, never meet on that day. Section D has been compelled to split up into three subsections, and probably most of the sections will have to meet on Wednesday morning. The social distractions have been much more numerous than usual, and we suspect have somewhat seriously interfered with the legitimate work of the meeting. As might be expected, the Music Hall was crowded on Wednesday evening to hear the President's address, which seems to have produced a great impression on the audience.

It is being more and more strongly recognised [illegible] such pre-arrangem[illegible] those of Sections A and [illegible] ought to become [illegible] ughout the sections [illegible] discussions in [illegible] ctions, of which the pro[illegible] grammes have [illegible] NATURE, have certain[ly] excited great i[illegible] orkers in physic[illegible] chemistry. It i[illegible] abstract [illegible] discussions will b[illegible] others [illegible] [c]annot have any g[illegible] Perh[illegible] popular featur[illegible] the reading of Si[illegible] D, on Friday. [illegible] [n]umber of enterta[illegible] conversazion[illegible] in the A[illegible] successful, [illegible] and fru[illegible] [illegible] di[illegible]

Prof. Traill, the nucleus of a valuable local natural history collection has been formed. Prof. Osborne Reynolds's illustrations of compression of solids was one of the most attractive features of the evening. The collection of pictures was large and highly creditable, while the precious collections of old manuscripts and books lent by the Earl of Crawford had many admirers. One of the most successful afternoon parties was given the same day at Tollshill Wood by Mr. David Stewart. Of course, of the numerous Saturday excursions, that to Balmoral was the most popular. In spite of the wretched weather 200 people must have left Aberdeen for Ballater at 1 p.m. and happily by the time the end of the railway journey was reached the weather greatly improved. The drive from Ballater to Balmoral evidently gave great enjoyment to the occupants of the long cavalcade of miscellaneous "machines" which wound along the banks of the Dee, and no less, we may be sure, did the sumptuous five o'clock dinner ("lunch," it was called) which was provided in the ball-room of Balmoral. Gen. Gairdner presided at the table, and, after proposing the Queen's health, drank, by command of Her Majesty, prosperity to the British Association. Under the guidance of Dr. Profeit the guests made a round of the fine grounds of Balmoral, and on driving back to Ballater, passed Her Majesty on her return from a day's outing. The excursion to Dunecht was also a great success, the arrangements at Lord Crawford's observatory exciting much interest.

A deputation from Birmingham is here to make arrangements for the visit to that town next year. It is evident that the Birmingham people mean to make the 1886 meeting a success, though, so far as social arrangements go, it will be difficult to surpass that of Aberdeen. It is expected that Manchester will be the place of meeting in 1887, and for 1888 or 1889 several enterprising members hope to secure the selection of London, in order to have a meeting in common with the American Association. Against this choice, however, there will probably be a strong protest, though of course the American Association will be sure to receive an enthusiastic welcome whenever it chooses to visit the old country.

Prof. Adams's lecture on Friday attracted a large audience, and on Saturday evening the Music Hall was filled with an enthusiastic audience of genuine working men to listen to Mr. H. B. Dixon's lecture and admire his experiments. Mr. Murray's lecture to-night will certainly be of popular interest, but, summing up as it does the present position of oceanography, it will also be of the highest scientific value. The diagrams are very striking, and certainly original. A full report will no doubt appear in NATURE.

The regret at the resignation of the secretaryship of the Association by Prof. Bonney is universal, though it is confidently expected that Mr. Atchison will be a thoroughly competent successor.

The additional arrivals up to this morning will bring the total number present at the meeting up to 2500.

## SECTION B

### CHEMICAL SCIENCE

OPENING ADDRESS BY PROF. HENRY E. ARMSTRONG, PH.D., F.R.S., SEC. C.S., PRESIDENT OF THE SECTION [1]

pass to the consideration of a subject of special interest
ion, which I think requires the immediate earnest
chemists and physicists combined—that of *Chemical*
his Presidential Address to the Association last
d Rayleigh made only a brief reference to
any of us must have felt that his few remarks
meaning, especially his reference to the im-
iple of the dissipation of energy in relation
year's reflection has led me to think
ness and full of prophecy. I would especially draw attention to the closing paragraph of this portion of his address: "From the further study of electrolysis we may expect to gain improved views as to the nature of the chemical reactions, and of the forces concerned in bringing them about. I am not qualified—I wish I were—to speak to you on recent progress in general chemistry. Perhaps my feelings towards a first love may blind me, but I cannot help thinking that the next great advance, of which we have already some foreshadowing, will come on this side. And if I might, without presumption, venture a word of recommendation, it would be in favour of a more minute study of the simpler chemical phenomena."

Chemical action may be defined as being any action of which the consequence is an alteration in molecular constitution or composition; the action may concern molecules which are of only one kind—cases of mere decomposition, of isomeric change and of polymerisation; or it may take place between dissimilar molecules—cases of combination and of interchange. Hitherto it appears to have been commonly assumed and almost universally taught *by chemists* that action takes place directly between A and B, producing AB, or between AB and CD, producing AC and BD, for example. This, at all events, is the impression which the ordinary average student gains. Our text-books do not, in fact, as a rule, deign to notice observations of such fundamental importance as those of De La Rive on the behaviour of nearly pure zinc with dilute sulphuric acid, or the later ones of Faraday ("Exp. Researches," Series vii., 1834, 863, *et seq.*) on the insolubility of amalgamated zinc in this acid. Belief in the equation $Zn + H_2SO_4 = H_4 + ZnSO_4$ hence becomes a part of the chemist's creed, and it is generally interpreted to mean that zinc *will* dissolve in sulphuric acid, forming zinc sulphate, not, as should be the case, that *when* zinc dissolves in sulphuric acid it produces zinc sulphate, &c. In studying the chemistry of carbon compounds we become acquainted with a large number of instances in which a more or less minute quantity of a substance is capable of inducing change in the body or bodies with which it is associated without apparently itself being altered. The polymerisation of a number of cyanogen compounds and of aldehydes, the "condensation" of ketonic compounds and the hydrolysis of carbohydrates are cases in point; but so little has been done to ascertain the nature of the influence of the contact-substance, or *catalyst*, as I would term it, the main object in view being the study of the product of the reaction, that the importance of the catalyst is not duly appreciated. Recent discoveries, however—more particularly Mr. H. B. Dixon's invaluable investigation on conditions of chemical change in gases, and the experiments of Mr. Cowper with chlorine and various metals, and of Mr. Baker on the combustion of carbon and phosphorus—must have given a rude shock, from which it can never recover, to the belief in the assumed simplicity of chemical change. The inference which I think may fairly be drawn from Mr. Baker's observations—that *pure* carbon and phosphorus are incombustible in *pure* oxygen—is indeed startling, and his experiments must do much to favour that "more minute study of the simpler chemical phenomena" so pertinently advocated by Lord Rayleigh.

But if it be a logical conclusion from the cases now known to us that chemical action is not possible between any two substances other than elementary atoms, and that the presence of a third is necessary, what is the function of the third body—the catalyst—and what must be its character with reference to one or both of the two primary agents? In the discussion which took place at the Chemical Society after the reading of Mr. Baker's paper, I ventured to define chemical action as *reversed electrolysis*, stating that in any case in which chemical action was to take place it was essential that the system operated upon should contain a material of the nature of an electrolyte (Chem. Soc. *Proc.*, 1885, p. 40). In short, I believe that the conditions which obtain in any voltaic element are those which must be fulfilled in every case of chemical action. There is nothing new in this; in fact, it practically was stated by Faraday in 1834 ("Experimental Researches in Electricity," series vii. §§ 858, 859 [1]); and had due heed been given to Faraday's teachings we

[1] ued from p. 453.

[1] "Those bodies which, being interposed between the metals of the voltaic pile, render it active, *are all of them electrolytes*, and it cannot but press upon the attention of every one engaged in considering this subject, that in those bodies (so essential to the pile) decomposition and the transmission of a current are so intimately connected that one cannot happen without the other. If, then, a voltaic trough have its extremities connected by a body capable of being decomposed, as water, we shall have a continuous current through the apparatus; and whilst it remains in this state we may look at the part where the acid is acting upon the plates and that where the current

should scarcely now be so ignorant as we are of the conditions of chemical change.

The questions—What is Electrolysis? What is an Electrolyte? are all-important to the chemist, if my contention be accepted. Moreover, the consideration of chemical action from this point of view almost of necessity obliges us also to consider what it is that constitutes chemical affinity. I will not presume to offer any opinion on this subject; but I would recall attention to the prominence which so great an authority as Helmholtz gave in the last Faraday Lecture (Chem. Soc. *Trans.*, 1881, 277) to the view held by Faraday, and which is so definitely stated in a passage in his "Experimental Researches" (series vii. 918, also 852 and 869).

Helmholtz used the words: "I think the facts leave no doubt that the very mightiest among the chemical forces are of electric origin. The atoms cling to their electric charges, and opposite electric charges cling to each other; but I do not suppose that other molecular forces are excluded, working directly from atom to atom. In the passages which immediately follow, this physicist then makes several statements of extreme importance, which directly bear upon the subject I desire to discuss, and which, therefore, I quote.[1]

The interpretation of Faraday's law of electrolysis, which Helmholtz has brought under the notice of chemists, is of the most definite and far-reaching character. Does it, however, at all events in the form in which he has put it forward, accord [illegible]

[illegible]

sufficiently with the facts as these present themselves [illegible] chemist's mind? All will recognise that the chemical changes effected by a current in a series of electrolytic cells are equivalent to those which take place within the voltaic cells where the current is generated; but in neither case is the action of simple character: in both a variety of chemical changes take place, the precise character of which is but imperfectly understood, and we are unable to assign numerical values, either in terms of heat or electrical units, to most of the [illegible]. Moreover, many compounds are not electrolytes, which are regarded by the chemist as their analogues [illegible] readily decomposed by a current of low E.M.F., although a great difference is to be observed in their "heats of formation"; liquid hydrogen chloride on the one hand, and fused [illegible] chloride on the other, may be cited as examples. Again, how are we to interpret on this theory such changes as that involved in the conversion of stannic into stannous chloride? The former, I suppose, is to be regarded as consisting of an atom of quadrivalent tin charged with four units of, say, positive electricity, and of four atoms of univalent chlorine, each carrying a unit charge of negative electricity; on withdrawal of two of the chlorine atoms, the residual $SnCl_2$ will have two [illegible] charges of positive electricity. We know that when the temperature is sufficiently lowered two such residues unite, forming $Sn_2Cl_4$, and it is not improbable that crystalline stannous chloride represents a still later stage of condensation. Is this compatible with the theory? That cases of this kind are contemplated would appear from the reference to "unsaturated compounds with an even number of unconnected units of affinity," which we are told may be charged with equal equivalents of opposite electricity; and also from the allusion to the existence of molecules of elementary substances composed of two atoms. It is more than probable that these anomalies would disappear if a fuller statement of his views by the author of the theory [illegible]; [illegible] call attention to them in the hope of [illegible].

Helmholtz tells us that electrolytes belong to the class of typical compounds, the constituents of which are united by "atomic affinities," not to the class of "molecular aggregates" [illegible]. Before chemists can accept this [illegible] definition must be removed which appears to [illegible] [illegible]. In the first place, it is in the highest degree [illegible] that, with the one single exception of [illegible] *hydride or* [illegible] *the liquid state* [illegible] liquid hydrogen chloride, bromide and iodide, for example, [illegible] E.M.F. of over 8,000 volts (8,040 De la Rue [illegible]). Water, again, according to Kohlrausch [illegible] [illegible], has an almost infinite resistance [illegible] hydrogen chloride and water readily conducts, and [illegible] solution of sulphuric acid [illegible] although the acid itself has a very high resistance. [illegible] examples might be quoted, but it [illegible] [illegible] generally conduct [illegible] [illegible], and are electrolysed.[2]

The [illegible] among physicists would appear to be the [illegible] electrolyte—the acid or the salt—is almost [illegible] decomposed (Wiedemann, "Elektricität," [illegible]). We are [illegible] told that sulphuric acid [illegible] [illegible] the chemist desires to know [illegible] conducting. It may be that in all [illegible] "[illegible] compound" is the actual electrolyte—*is the body* decomposed by the electric current—*but the actions only take place in* [illegible] *compounds are* [illegible] *and* [illegible] [illegible] for it is an undoubted fact that HCl and $H_2SO_4$ [illegible] water, forming "hydrates." This production of [illegible] "electrolytical system" from dielectrics is, I venture to think, an important question for chemists to consider. I do not

[1] [illegible] that the most nearly pure sulphuric acid [illegible] homogeneous, but is at least a mixture of $H_2SO_4$ [illegible] compounds" in proportions depending on the temperature, [illegible] liquid sulphuric acid, $H_2SO_4$, [illegible] behaves as a dielectric.

[2] On the other hand, it is remarkable that, whereas liquefied ammonia [illegible] [illegible]

... state the exact conditions under ... take place until a satisfactory ...

... 1879, xxx. 233) has shown that, ... the electric conductivity ... about 30 per cent. of acid ... attained; conductivity then ...

may be largely due to diminution ... and increase in the rate of diffusion.

Our knowledge of the binary ... compounds, which are generally admitted to be electrolytes, ... also affords evidence, ... relation between chemical constitution and ... It has been pointed out ... that whereas all the ... chlorides and analogous compounds which ... are ... only ... the ... decompose only at high temperatures. ...

[illegible]

important bearing on the discussion of the nature of the chemical changes which occur during the dissolution of metals. Formerly it was said that when zinc acts upon dilute sulphuric acid, the zinc displaces the hydrogen of the water and the resulting zinc oxide dissolves in the acid, forming zinc sulphate; the modern explanation advocated by most chemists has been that the metal directly displaces the hydrogen of the acid—in fact, that this is the nature of the change whenever an acid is acted upon by a metal. If a solution of sulphuric acid, of whatever strength, [illegible]

[illegible]

Having thus fully [illegible] why I [illegible] think that Helmholtz's [illegible] [illegible]

[illegible]

My own view [illegible] [illegible] Williamson [illegible] [illegible] elements—i.e. [illegible] was first pointed out, I believe, by Lothar Meyer, the negative elements [illegible] positive elements. The view I take, then, is, that in the majority of [illegible] molecular compounds the [illegible] are perceived [illegible] in the sense in which a [illegible] [illegible] ethyl [illegible] compound, being held together by the [illegible] affinity [illegible] Thus I would [illegible] the compounds $K_2CuCl_4$ and $K_2HgCl_4$ as containing copper and mercury of the same valency as the metal in the parent chloride, and regard them as compounds of the [illegible] ($HgCl_2$) and (KCl) [illegible] a view which may be expressed by the formulæ

$$Cu\begin{matrix}Cl.ClK\\Cl.ClK\end{matrix} \qquad Hg\begin{matrix}Cl.ClK\\Cl.ClK\end{matrix}$$

The arsenic compounds referred [illegible] may be similarly represented [illegible]

$$[illegible]\ AsF.FK \qquad [illegible]As\begin{matrix}F.FK\\F.FK\end{matrix}$$

We do not hesitate to attribute to the so-called double cyanides this order of structure, without in any way supposing the metal changes in valency. Evidence that the "[illegible] [illegible] case unchanged in molecular compounds" is [illegible] facts such as that ferrous and potassium chlorides [illegible] form a compound which obviously is still ferrous, [illegible] green colour, which would hardly be the case if the [illegible] the iron were increased; and that in like manner the [illegible] formed from stannous chloride manifest all the [illegible] stannous derivatives.

Whatever be the nature of chemical affinity, it is [illegible] to [illegible] the conclusion that the "charge" of a [illegible] especially is rarely, if ever, given up all at once, that [illegible] is at once exhausted. It would also appear that the [illegible] residual charge—of surplus affinity—possessed by a [illegible] combination with others depends both on its own [illegible] that of the radical or radicals with which it becomes [illegible] Differences such as are observed in the composition and [illegible] of the hydrates of the salts of an acid—the sulphates, [illegible] ample clearly point to this. Other illustrations are [illegible] by the manner in which chlorhydric acid yield [illegible] some metals and chlorides of others.[1]

It is noteworthy, however, that often those elements [illegible] from the ordinary point of view are regarded as [illegible] feeble affinities are those which manifest the greatest [illegible] to form molecular compounds. Thus it is commonly held [illegible] of the three elements, chlorine, bromine and iodine, chlorine [illegible] the highest and iodine the lowest affinity, and this view [illegible] well with the recent observations of V. Meyer on the [illegible] stability of their diatomic molecules at high temperatures; nevertheless we find that the compound which HI forms [illegible] $HI_2$ is far more stable than that of HBr or HCl [illegible] and it is well known that mercuric iodide has a [illegible] affinity for other iodides than have mercuric bromide and [illegible] for the corresponding bromides and chlorides.[2]

The recognition of the peculiarity in the negative [illegible] which I would attribute the formation of molecular [illegible] must, I think, exercise an important influence [illegible] and directing the investigation of these compounds [illegible] pounds other than those of carbon; in the near future [illegible] mination of the structure of such compounds should [illegible] portant share of the chemist's attention. It will perhaps [illegible] clear up not a few cases which are not altogether satisfactorily [illegible] preted in accordance with the popular view of valency, [illegible] stance the formation of (?) polymeric metaphosphates, [illegible] ates of silicates and tungstates, and of compounds of [illegible] with trinitrophenol. It may even serve to explain [illegible] the [illegible] of the more complex carbohydrates.

It is one of the most clearly established of the "laws of [illegible] [illegible] carbon compounds that negative radicals [illegible] accumulate [illegible] instances are afforded by the [illegible] of paraffinoid compounds with chlorine, bromine and [illegible] [illegible] and by that of unsaturated paraffinoid compounds [illegible] [illegible] with hydrogen bromide and iodine. The [illegible] affinity of negative elements for negative is not improbably [illegible] cause of this accumulation. A similar explanation may perhaps be given of some of the peculiarities which are manifested [illegible] benzenoid compounds.

I would even venture to suggest that in electrolysing [illegible] the fraction arising from the attraction of the ions for each other is perhaps diminished, not by the mere mechanical interposition of the water molecules of the solvent—as [illegible] by Kohlrausch—but by the actual attraction exercised by the molecules upon the negative ion in virtue of the affinities of [illegible] negative molecule.

One result of increased attention being paid to the investigation

[1] The term chlorhydric acid is here applied to the compound [illegible] [illegible] according to Thomsen, is present in [illegible] [illegible] speak of HF, HCl, HBr, HI, as acids, and [illegible] It would be an advantage if we [illegible] [illegible] fluoride, chloride, bromide, iodide and [illegible] always termed them [illegible] respectively. The [illegible] [illegible] with equal advantage be altogether [illegible] [illegible] as suggesting a relation [illegible] The [illegible] and anhydric, as applied to the [illegible] [illegible] of the hydrides, are especially appropriate [illegible] [illegible] compounds containing the radical water—that [illegible] would be well to restrict the use of hydric and [illegible] [illegible] and to speak of hydrides as hydro-, not as hydro- [illegible] It would thus be possible to give comparatively simple [illegible]

[2] Thomsen gives the [illegible] in heat units as—

| | | |
|---|---|---|
| $HgCl_2, 2KClAq$ | = | [illegible] |
| $HgBr_2, 2KBrAq$ | = | [illegible] |
| $HgI_2, 2KIAq$ | = | [illegible] |
| $HgCy_2, 2KCyAq$ | = | [illegible] |

with authority, but in the hope that I may be the "fool," and that the "angels" who are well able to discuss them will be led to do so without delay: for chemists are anxiously awaiting guidance on matters such as I have referred to.

Attention must, however, be directed to the study of electrical phenomena by the recent publications of Arrhenius and of Ostwald (*Journal für praktische Chemie*, 1884, 30, 93, 225; 1885, 31, 219, 433), and especially by the statement put forward by the latter that the rate of change under the influence of acids (in hydrolytic changes) is exactly proportional to the electrical conductivity of the acids. There cannot be a doubt that these investigations are of the very highest importance.

I trust that in the [illegible] which we are to have on molecular weights of liquids and solids, and on electrolysis, there may be a free exchange of opinion on some of the points here raised. My reason for selecting these subjects for discussion at this Section will, I [illegible] sufficiently clear, I imagine. Last year in the Physical Section the idea was mooted [illegible] of the Association, [illegible] the reading of abstract papers, which rarely are, or can be, discussed. Two important discussions were *introduced* by Profs. Lodge and Schuster. We must all cordially agree with Prof. Lodge [illegible] on the importance of [illegible] subjects of general interest at these meetings. It appears to me, however, that even a more important work may often be accomplished if the discussion consist of a series of papers which together form a monograph of the subject. I have endeavoured to carry the idea [illegible] in the present [illegible], and a number of friends have most kindly consented to assist. Unexpected difficulties have arisen, and probably we shall come in [illegible] in doing all we might wish. I trust, however, that the Section will approve of this first attempt, sufficiently to justify my successors in this chair in adopting a similar course.

I much regret that it is impossible for me to attempt any review of recent work in chemistry. Not a few really important discoveries might be chronicled, and the patient industry of many who have toiled long to win results apparently insignificant should have been mentioned with high approval. A few remarks I will crave permission for, as regarding the general character of the work being done by chemists, and regarding that which has to be done.

Complaints are not unfrequently made in this country that a large proportion of the published work is of little value, and that chemists are devoting themselves too exclusively to the study of carbon compounds, and especially of synthetical chemistry. We are told that investigation is running too much in a few grooves, and it is said that we are gross worshippers of formulæ. [illegible] of these critics are [illegible] that [illegible] which consists in assigning a higher value to the particular class of work with which one happens to be engaged or interested in than to any other line of investigation; too frequently they result from want of sympathy with, if not absolute ignorance of, the scope and character of the work complained of. It must not be forgotten that chemical investigation, like other investigation, is to a large extent the work of pioneers; the path once [illegible] [illegible] in the order of these [illegible] and [illegible] [illegible] work in grooves. The attention paid to the study of carbon compounds may be [illegible] the [illegible] of [illegible] the nature of the [illegible] [illegible] elements [illegible] [illegible] compounds of the [illegible] kingdom, both animal and vegetable, [illegible] wonder, there [illegible] directly bearing upon [illegible] the most attractive to the living. [illegible] physiologist [illegible] that probably 95 per cent of the [illegible] of living [illegible] are [illegible], and that the [illegible] chemical changes which [illegible] living life [illegible] [illegible] in mystery. It is [illegible] that this may no longer be the case, that the study of carbon compounds is being so vigorously prosecuted [illegible] [illegible] the knowledge of [illegible] and of chemical function —are now rapidly being sharpened, but we are yet far from ready for the attack. As to the value of this work, I believe that every fact honestly recorded is of value. An infinite number of examples might be quoted to prove [illegible]. No unprejudiced reader can fail to be struck also with the improvement in quality which is manifest in the majority of the investigations now published; at no time was more attention given to the discovery of all the products of the reactions studied, and to the determination of the influence of changes in the conditions. [illegible] our formulæ, those who look upon the outward [illegible] without proper knowledge of the facts symbolised, and [illegible] no pains to appreciate the spirit in which they are constructed, [illegible] undoubtedly misled by them. The great [illegible] of carbon-chemists has been, however, the establishment of the doctrine of structure;[1] that doctrine has received [illegible] powerful support from the investigation of physical properties, and it may almost, without exaggeration, be said to have been rendered visible in Abney and Festing's infra-red spectrum photographs. Some of us look forward to the extension of the doctrine of structure not only to compounds generally, but even to the "elements." The relationships between them are in many cases so exactly similar to those which obtain between carbon compounds, which we are persuaded differ merely in structure, that it is almost impossible to avoid such a conclusion even in the absence of all laboratory evidence.[2]

As the field of view opens out before us, so does the [illegible] of the work to be accomplished become more and more apparent; and Faraday's words of 1834 may be quoted as even more appropriate than half a century ago.

"Indeed, it is the great beauty of our science, Chemistry, that advancement in it, whether in a degree great or small, instead of exhausting the subjects of research, opens the doors to further and more abundant knowledge, overflowing with beauty and utility, to those who will be at the easy personal pains of undertaking its experimental investigation."

## SECTION C

### GEOLOGY

OPENING ADDRESS BY PROF. J. W. JUDD, F.R.S., [illegible], PRESIDENT OF THE SECTION[3]

Concerning the overlying formation of quartzite [illegible], much yet remains to be made out. Nicol [illegible], [illegible] the officers of the Geological Survey, have shown it [illegible] made up of three principal members—the identity of which [illegible] be mistaken although different names have been assigned [illegible] them. While Nicol estimated the total thickness of the [illegible] at from 300 to 800 feet, however, and Lapworth places [illegible] the smaller of these amounts, the officers of the Survey who [illegible] to be not less than 2,000 feet thick.

Even greater uncertainty still exists as to the exact geological age of this important formation. Murchison, who in his later years made "Silurian" a mere synonym for Lower Palæozoic, was no doubt right in regarding these rocks as being of this age. I have no intention of attempting to flog that dead horse—the controversy concerning the names which should be applied to the great system containing the three faunas which Barrande so well showed to be present in the Lower Palæozoic rocks. The controversy, commencing, it must be confessed, with some [illegible] elements, has long since passed into the sphere of comedy, and now bids fair, if still persisted in, to degenerate into farce.

[illegible], if anything, has been added to the work of Salter in connection with these fossils of the Durness limestone. With the [illegible] of that remarkable and aberrant mollusc, *Maclurea*, they can be paralleled with no other British or even European deposit, unless it be the Stinchar limestone of the Girvan district. Salter thought that this remarkable Scotch formation had its nearest analogues in the Calciferous sandstone and the Chazy limestone of North America. As these rocks contain "Primordial" [illegible] of [illegible], they must probably be regarded as [illegible] of [illegible] age, or as constituting a link between the [illegible] containing Barrande's first and second faunas respectively. Under these circumstances, it is a piece of welcome intelligence that the officers of the Geological Survey have succeeded in obtaining a rich and varied collection of organic remains from the beds of Sutherland; and the results of the examination and description of these fossils will be awaited by all geologists with the greatest interest.

Whether, as in the case of Scandinavia, other fossiliferous [illegible]

[1] I venture here to direct attention to an extension of the acknowledged theory of [illegible] suggested by myself (I may say) at the close of [illegible] [illegible] vol. [illegible], [illegible] edition, p. [illegible]). The same view was soon afterwards [illegible] [illegible] in Miller's "Chemistry" [illegible] by Dr. Perkin.

[2] I have [illegible] paper (*Monatshefte für Chemie*, 1885, p. [illegible]) "On a New Method of [illegible] the Size of Molecules," actually puts forward an hypothesis as to the structure of elements.

[3] Continued from p. [illegible].

deeply by gigantic earth-throes, or sealed up under massive lava-streams.

Down to post-glacial times Scotland, and what are now its outlying islands, remained united with Scandinavia. I need not remind you how, during the glacial period, they were the scene of a similar succession of events; while from their then far more elevated mountain summits streams of glacier-ice flowed down and relieved the mantle of snow which enveloped them.

But at a very recent geological period, and indeed since the appearance of man in this part of our globe, the separation of the two areas, so long united, was brought about. In the district now constituting the North Sea, which separates the two countries, great faults, originating in the Tertiary epoch, appear to have let down wide tracts of the softer Secondary strata among the harder crystalline rock masses. The numerous changes of level, of which we find such abundant evidence around the shores of this sea, [illegible] the wearing away of the whole of these softer Secondary deposits, except the slight fringes that remain along the shores of Sutherland, Ross, and Cromarty, on the one hand, and the [illegible] Jutland and the [illegible] [illegible] the Vikings, as they [illegible] in these regions were able to [illegible] from Norway to [illegible]

It is almost impossible to over-estimate the effects produced by the several denudations to which Scandinavia and the Scottish Highlands have been successively subjected. In that which occurred during the later Tertiary periods, almost every portion of [illegible] crystalline rocks that rose above the sea-level was either entirely removed or [illegible] to a level plain, which, covered with drift deposits, now forms [illegible] like Scania and [illegible]. Where, as in the great central valley of Scotland, [illegible]

[illegible]

rocks, including several thousands of feet of Triassic, [illegible] and Jurassic strata, has been let down by a gigantic fault, [illegible] to be placed in juxtaposition with the Old Red Sandstone [illegible] the crystalline rocks. Now, taking the very lowest estimate [illegible] the thicknesses of the several strata affected, the vertical [illegible] of this fault must have exceeded a mile! It may not [illegible] indeed, have been at least double or treble that amount. [illegible] this great dislocation was certainly produced at a later date [illegible] the Upper Jurassic period, for rocks of that age are found [illegible] affected by it.

Along the coasts of the Black Isle, strata of Middle [illegible] Upper Jurassic age are similarly found faulted against the "[illegible] Red" and the crystalline rocks.

On the other side of the North Sea, in Ando, one of the Lofoten Isles, a patch of Lower-Oolite strata, [illegible] marine and estuarine strata, and including beds of coal [illegible] of Brora, is found let down by gigantic faults into the very [illegible] of the crystalline rocks of the district. In Scania, the [illegible] the Secondary rock-masses owe their preservation in the [illegible] way to a plexus of tremendous faults, by which they have [illegible] entangled among the harder rocks. These faults have [illegible] not only the Jurassic strata, but even the very youngest [illegible] of the Cretaceous series.

Nor are we without evidence that some of the great [illegible] of post-Cretaceous age, in this country, for in the Western [illegible] faults displacements of several thousands of feet have been [illegible] which affect not only the Upper Cretaceous, but also the [illegible] Tertiary rocks.

The effects produced by these great dislocations, which [illegible] a generally parallel direction in our Highlands, [illegible] [illegible] one of the most startling character. [illegible]

[illegible]

marked the practical close of one great series of controversies. The discussions of the present meeting will, I trust, result in the recognition and clear statement of a number of other equally important problems of Highland geology which still await solution. And I am sanguine enough to hope that when this Association next gathers here, my successor in this chair will have to congratulate his audience upon a very brilliant retrospect of work actually accomplished in the interval.

I am encouraged in this optimism by the fact that in the period which has elapsed since our last meeting here, great and important improvements have been made in the methods of geological investigation. We have seen how the discovery of a few fragmentary shells in the limestone of Durness, and of sundry casts of bones in the sandstone of Elgin, have been the means of profoundly modifying our ideas concerning the age of vast tracts of rock in the Highlands. The development of modern methods of petrographical research is destined, I believe, to lead to a similar revolutionising of our views concerning the wonderful series of changes which have taken place within rock-masses, subsequently to their original accumulation.

Especially does the application of the microscope to the study of rocks, when employed in due subordination to, and illustration of, work done in the field, promise to be the source of valuable and fruitful discoveries in the field of Highland geology.

In connection with this subject, I cannot refrain from reminding you that while the initiative in the application of the palæontological method of research was taken by an English land-surveyor, we are indebted to a Scotchman in an equally lowly station of life, for overcoming some of the first difficulties in connection with petrographical study. Many microscopists had employed their instruments, and sometimes with useful results, in the study of the powders and the polished surfaces of rocks; but it is to William Nicol, of Edinburgh, the inventor of the well-known polarising prism which bears his name, that we owe the discovery of the method of preparing transparent sections of fossils, crystals, and rocks, whereby their internal structure may be examined by transmitted light. Nicol bequeathed his preparations to his friend Alexander Bryson, and some of them are now preserved in the British Museum. It is interesting, too, to recall the circumstance that it was a thin section of the granite of Aberdeen in the collection of Bryson which exhibited to Sorby that wondrous assemblage of minute cavities containing liquids, and led him, shortly before our previous meeting here, to write his paper "On the Microscopical Study of Crystals, indicating the origin of Minerals and Rocks"—a paper which has indeed proved epoch-making in the history of geology.

Before concluding the remarks which by your kindness I have been permitted to offer you to-day, I cannot forbear from indulging in a pleasant reminiscence of a personal character. Nearly fifteen years have passed away since I first visited the Highlands for the purpose of geological study; it was at that time I first found myself at liberty to put into practice a scheme cherished by me from boyhood, that of studying those Secondary rocks and fossils of the Highlands among which such valuable pioneer work had been done by John Macculloch, Roderick Murchison, and Hugh Miller. I had endeavoured to prepare myself for a somewhat difficult task, by a training partly unofficial and partly official—I will not employ the terms "amateur" and "professional," for of late they have been so sadly misused—but when I came a stranger among you, I could not have deserved, and I certainly did not anticipate, that cordial welcome, that kindly aid and that generous appreciation, of which I accept my position here to-day as the crowning manifestation.

While I continue to occupy myself with the glorious problems of Highland geology—and hitherto I have found that each difficulty surmounted has resulted, like the sown teeth of the slaughtered dragon, in a plentiful crop of new ones—the many acts of kindness of my numerous friends here can never [illegible] be present in my mind. For not only am I indebted [illegible] who, like your own Dr. Gordon, of Birnie, and [illegible] Golspie, have been able out of stores of their k[illegible] furnish me with "things new and old," and who h[illegible] failing in their aid and sympathy, but to those al[illegible] pitied, but nevertheless helped, the "daft callan [illegible] after the chucky stanes."

I know of no higher pleasure than that which the ge[illegible] experiences in visiting regions of great scientific interest [illegible] are new to him, and of grasping the hands of fellow-workers whose labours and teachings he has learned to admire and to appreciate. Whatever may be my lot in this way in future years, however rich the country visited may be in objects of profound instructiveness or of surpassing interest, I can anticipate or desire nothing more valuable than the lessons, or kinder than the reception which I have met with here.

> "I'll ask na mair, when I get there,
> Than just a *Hielan* welcome."

## SECTION D

### BIOLOGY

OPENING ADDRESS BY PROF. W. C. MCINTOSH, M.D., LL.D., F.R.SS.L. & E., F.L.S., COR. M.Z.S., PRESIDENT OF THE SECTION

I HAVE selected the subject of the phosphorescence of marine animals for a few remarks on the present occasion—the theme, perhaps, being the more appropriate from its congenial local surroundings; for, like St. Andrews, Aberdeen is an

> "Old University town
> Looking out on the cold North Sea."

A phenomenon so striking as the emission of light by marine organisms could not fail to have attracted notice from very early times, both in the case of navigators and those who gave their attention in a more systematic manner to the study of nature. Accordingly we find that the literature of the subject is both varied and extensive—so much so, indeed, that it is impossible on the present occasion to give more than a very brief outline of its leading features. This is a subject of less moment, however, since the great microscopist, Ehrenberg, in his treatise, "Das Leuchten des Meeres," published by the Berlin Academy in 1835, has given a very full account of the early literature of phosphorescence, both in marine and terrestrial animals, no less than 436 authors being quoted. The limitation just mentioned is therefore sufficiently warranted.

Though it is in the warmer seas of the globe that phosphorescence is observed in its most remarkable forms—as for instance, the sheets of white light caused by *Noctiluca*, and the vivid luminous bars of *Pyrosoma*—yet it is a feature which the British zoologist need not leave his native waters to see both in beauty and perfection. Many luminous animals occur between tide-marks, and even the stunted sea-weeds near the line of high water everywhere sparkle with a multitude of brilliant points. As a ship or boat passes through the calm surface of the sea in summer and autumn, the wavelets gleam with phosphorescent points, or are crested with light; while the observer, leaning over the stern, can watch the long trail of luminous water behind the ship, from the brightly sparkling and seething mass at the screw, to the faint glimmer in the distance. On the southern and western shores, again, every stroke of the oar causes a luminous eddy, and some of the smaller forms are lifted by the blade and scintillate brightly as they roll into the water. The dredge and trawl likewise produce, both in the shallower and deeper parts of our seas, many luminous types of great interest and beauty.

I shall, in the first instance, glance at the various groups of marine animals which possess the property of phosphorescence, and thereafter make some general remarks on the subject. It is found then that this feature is possessed by certain members of the Protozoa, and by [illegible] wing groups of the Metozoa,—viz. Cœlenterates, [illegible] Worms, Rotifers, Crustaceans, Molluscoids, Mo[illegible]

About the mi[illegible] Baster found that at least three species of wh[illegible] ic animalcula ("Opuscula Subseciva," vol. i. [illegible] ), apparently [illegible] were phosphorescen[illegible] noticed that the lumin[illegible] members of the group [illegible] Michaelis and Ehrenberg [illegible] the Baltic, the latter descri[illegible] (now *Ceratium*) and *Pror*[illegible] with the absence of *Noctiluca* a[illegible] forward by Stein. In [illegible] with this featu[illegible] moment as the ripple stretches outward, and then disappear; or, still more vividly, when the plunging vessel sends the sparkling spray all around the bow. If, on removing the tow-net from such water at night it is suddenly jerked, the whole interior is beautifully lit up with a luminous lining, which glows brightly for a few seconds and then fades. I have been unable, nevertheless, to satisfy myself as to the phosphorescence of isolated examples of *Ceratium*, and Mr. Murray (who is inclined to follow Klebs in considering them algæ), tells me that he has not been more successful.

The most conspicuous member of the first group (viz. the Protozoa), however, is *Noctiluca*, which for a long time has been associated with luminosity in many seas. The minute size of this little transparent gelatinous sphere, which ranges from ⅕ to ⅓ of a millimetre, probably gave origin to some of the ancient views that the phosphorescence of the sea originated from the water, and not from any visible organisms. Amongst the first who clearly made known the relationship of this minute body to the phenomenon we are examining was M. Rigaut, a French naval surgeon, who examined it off various parts of the French coasts as well as off the Antilles, and pointed out in a memoir communicated to the Academy that the luminosity of the sea was caused by an immense number of what he termed little spherical polyps, about a quarter of a line in diameter (*Journal des Savants*, tome xliii., February, 1770, pp. 554-61). The observations of this acute French surgeon were followed up by many subsequent authors, amongst whom may be mentioned Baker, Martin Slabber, Abbé Dicquemare, Suriray, Macartney, and Baird; while in more recent times Verhaege, De Quatrefages, and Giglioli have specially studied the phosphorescence of the sea caused by *Noctiluca*. The light given out by this form is occasionally spread over a large area, and is often evident along the margin of the beach, where the broad belts of Noctilucæ gleam in the broken water. It is not uncommon in summer on the southern shores of Britain, while it is rare in the northern; but it stretches into most of the great oceans, and is the cause of that diffused and silvery phosphorescence so well known to voyagers in the warmer seas. At Ostend, Verhaege found the maximum number in a given quantity of water in the warm months, few or none appearing in the winter. The observations of De Quatrefages ("Observations sur les Noctiluques," *Ann. des Sc. Nat.*, 3ᵉ Série, Zool., tom. xiv. p. 226) were made on the shores of France as well as those of Sicily, for he accompanied the distinguished Prof. Henri Milne-Edwards (whose loss science has had so recently to deplore), on his celebrated "Voyage en Sicile," and they were more extensive than those of the previous author. He attributes the emission of the clear bluish light in quiet water, or the white light with greenish or bluish touches in broken water, to any physical agent which produces contraction, the scintillations arising from the rupture and rapid contraction of the protoplasmic filaments in the interior. Thus, like Verhaege and others, he found no special luminous organ. Moreover, Ehrenberg and De Quatrefages observed that the light emitted by *Noctiluca*, though apparently uniform under a lens, was broken up into a number of minute scintillations when highly magnified. Mr. Sorby, in examining the light of this form, has been unable to obtain satisfactory spectroscopic results, apparently from its feebleness.

Besides *Noctiluca*, which was chiefly met with in inshore water, Mr. Murray, of the *Challenger*, describes various species of *Pyrocystis* (*Proc. Roy. Soc.*, vol. xxiv., p. 553, pl. xxi.; and *Narrative*, Zool., vols. i. and ii., pp 935-38), a closely-allied form, and indeed some of which have been thought to be identical with the former. They abound in the open sea, and are the chief causes of its phosphorescence in the tropical and subtropical oceans. The light is stated to proceed from the nucleus, and in this [illegible] diverges from that observed by De Quatrefages in [illegible]. When shaken in a glass they give out, Sir Wyville [illegible] observes ("Atlantic," vol. ii. p. 87), the uniform soft [illegible] illuminated ground-glass globe.

[illegible] during the voyage of the Italian frigate *Magenta*, [illegible] *della R. Accad. delle Sc. di Torino*, vol. v., 1869- [illegible] another group of the Protozoa, viz. the Radio- [illegible] properties. In the Pacific the genera [illegible] and *Sphærozoum* shone with an inter- [illegible]. It is possible that Dr. Baird (Loudon's [illegible] p. 312, Fig. 81, *c, d*), in his earlier [illegible] when describing an unknown

No group of marine animals is more prominent in regard to phosphorescence than the Cælenterates. The Hydroida are familiar examples (even after many days and in impure water some of these retain this property, a shock to the stem sending off a crowd of luminous points from the trophosome), and, as Mr. Hincks observes, none excels the common *Obelia geniculata*, which forms pigmy forests on the broad blades of Laminariæ all around our shores. In the fresh specimen a touch during summer causes a large number of luminous points to appear on the zoophytes, the stems most irritated emitting beautiful flashes, which glitter like faintly-dotted lines of fire, the points not being harshly separated, but blending into each other, while the shock imparted by the instrument detaches the minute medusoids, which scintillate upward from the parent stem to the summit of the water. Mere blowing on the surface in July, where Laminariæ abound, suffices to produce the emission of light from the pelagic buds. Moreover, these minute bodies, along with the various species of *Ceratium* and minute larval forms of diverse kinds, are sometimes swept by the gales landward, and cause phosphorescence where least expected. In the same manner Vaughan Thompson ("Zoological Researches," vol. i. part i. mem. iii. p. 48, 1829) found luminous patches on the masts and windward yardarms on board ship, and they gradually mounted upward as the gale increased. Many of the free gonosomes of the Hydroids are as luminous as the polypites, and indeed have been described by some of the older naturalists as one of the main causes of the luminosity of the ocean. The light in these (*e.g. Thaumantias*) gleams around the margin and along the four radii.

The Ascraspedote Medusæ have also been signalised as factors in producing the phosphorescence of the sea, such forms as *Pelagia noctiluca* and *Pelagia cyanella* being especially prominent. Spallanzani, indeed, made an elaborate series of experiments on the luminosity of the Medusæ in his voyage to the Two Sicilies. Some of these, as *Dactylometra* (*Pelagia*) *quinquecirra*, Agass., are nocturnal in their habits. They are only occasionally found floating at the surface during the day, while at night, in the same localities, the bottom swarms with these large masses of dull phosphorescence, moving about with the greatest rapidity (Agassiz, "North American Acalephæ," p. 49, Cambridge, 1865). Species of *Rhizostoma* were likewise observed by Giglioli to have a pale bluish luminosity. The two most abundant Medusæ of our eastern shores, viz. *Aurelia aurita* and *Cyanea capillata* (both in its young purple and adult brown condition), so far as I can make out, exhibit no luminosity. This agrees with the views expressed long ago by Ehrenberg.

The oceanic Hydrozoa (*Siphonophora*) are likewise characterised by their phosphorescence. Thus Giglioli met with luminosity in *Abyla*, *Diphyes*, *Eudoxia*, *Praya* and *Aglaismoides*. Dr. Bennett ("Gatherings of a Naturalist," p. 69, 1860) has also observed luminosity amongst the Coralligenous Actinozoa, the grazing of a boat on a coral reef causing a vivid stream of phosphoric light. Similar observations were made on Madrepores by Giglioli (*Atti della R. Accad. d. Sc. di Torino*, vol. v. p. 502), the light in this case being bright greenish and enduring some minutes.

Amongst the Alcyonarians the luminosity of the common Sea-Pen (*Pennatula phosphorea*) has been long known, and was studied by Gesner, Bartholin, Adler, and others. In the earlier part of this century Grant made the well-known and oft-quoted description (*Brewster's Edin. Journ.* vol. vii. p. 330, 1827), in which he pictures a *Pennatula* "with all its delicate transparent polypi expanded and emitting their usual brilliant phosphorescent light, sailing through the still and dark abysses by the regular and synchronous pulsations of the minute fringed arms of the whole polypi." But it ought to be balanced by his concluding statement, that the sea-pens are probably stationary, or "lie at the bottom, and move languidly like Spatangi, Asteriæ or Actiniæ" (certainly the specimens in the St. Andrew's Marine Laboratory were very helpless). Edward Forbes again observed that the light proceeded from the irritated point to the extremity of the polypiferous portion, and never in the opposite direction. As Dr. George Johnston tells us, Forbes induced Dr. George Wilson to test, along with Professor Swan, the polyps during phosphorescence by a delicate galvanometer, but without result. He thought the luminosity was due to a spontaneously inflammable substance.

More recently a series of interesting observations were made by Panceri on the structure and physiology of the luminous organs of this form. His conclusions are (1) that the light emanates from the polyps and zoids; (2) that the phosphorescent organs are the eight white cords adhering to the outer surface of the stomach, and that these are chiefly composed of cells containing a substance of a fatty nature, the oxidation of which causes the light. Panceri's conclusions further considerably modify Forbes's views about the direction of the waves or points of light. He supposes that the elements which stand in the place of nerves are capable of producing in the luminous batteries of the polyps a momentary oxidation—more rapid and more intense—accompanied by phosphorescence. Like those examined by Professor Milnes Marshall ("Report on the Oban Pennatulidæ," p. 49, Birmingham, 1882), the specimens at St. Andrews, after irritation, show a series of brilliant coruscations which flash along the rows of polyps in a somewhat irregular manner.

Two other Alcyonarians, *Funiculina* and *Umbellularia*, are equally phosphorescent. Though the former is familiar enough to some of the long liners of the outer Hebrides and west coast, it is rare that either is procured for scientific investigation. *Funiculina quadrangularis*, according to Forbes (Johnston's *Brit. Zooph.* vol. i. p. 166), gives out a vivid bluish light, which comes from the bases of the polyps, and appears to be connected with the reproductive system. Wyville Thomson ("Depths of the Sea," p. 149) describes the specimens procured in the *Porcupine* as resplendent with a steady pale lilac phosphorescence like the flame of cyanogen; and always sufficiently bright to make every portion of a stem caught in the tangles distinctly visible. The same zoologist mentions that the stem and polyps of *Umbellularia* are so brightly phosphorescent, that Captain Maclear found it easy to determine the character of the light by the spectroscope. It gave a restricted spectrum sharply included between the lines *b* and D ("Atlantic," vol. i. p. 151).

Besides the foregoing Alcyonarians, *Isis* and *Gorgonia* have been indicated as likewise phosphorescent. Dr. Merle Norman and Dr. Gwyn Jeffreys (whose death since the last meeting of the British Association is a serious loss to science) mention a beautifully luminous *Isis* on board the French ship *Le Travailleur*; and Sir Wyville Thomson ("Atlantic," vol. i. p. 119), with the facile and genial pen which characterised the lamented naturalist, gives a fascinating picture of a long, delicate, simple Gorgonian which came up in immense numbers in the trawl from 600 fathoms off the Spanish coast. He conjures up this Gorgonian forest as an animated cornfield waving gently in the slow tidal current, and glowing with a soft diffused phosphorescence, scintillating and sparkling on the slightest touch, and now and again breaking into long avenues of vivid light, indicating the paths of fishes or other wandering denizens of these enchanted regions. Prof. Moseley thinks that this brilliant phosphorescence of the Alcyonarians may be regarded as an accidental production, but that it may be of occasional service. Further, that the deep sea is at any rate lighted up by these Alcyonarians, which would thus form luminous oases round which animals with eyes might possibly congregate ("Notes of a Naturalist on the *Challenger*," p. 590).

The last group of the Cœlenterates, the *Ctenophora*, are even more conspicuous than the foregoing in regard to luminosity. It is indeed long since the Abbé Dicquemare descanted on *Cydippe* (*Pleurobrachia*) and Suriray on *Beroë*, while subsequent authors have made it clear that the majority of this group are phosphorescent. In our own seas, as Prof. Allman observes, *Beroë* at various stages is one of the most prominent luminous forms during certain seasons. Their enormous numbers make their effects more striking, though the intensity of the phosphorescence is less than that of the Medusæ. Quiet seas like Bressay Sound and the Firth of Forth are occasionally covered by a dense layer of these animals. Prof. Allman found that *Beroë* did not phosphoresce if suddenly taken from light into darkness, but that after they had remained about twenty minutes in obscurity they became luminous. Considerable variety exists in this respect at St. Andrews, some emitting light at once, others showing none. It is probable that this uncertainty is connected with the hygienic condition of the individuals.

In foreign seas many brightly luminous species are met with. Thus Prof. A. Agassiz ("North American Acalephæ," p. 20, Cambridge, 1865) describes *Mnemiopsis Leidyi* as "exceedingly phosphorescent, and when passing through shoals of these Medusæ, varying in size from a pin's head to several inches in length, the whole water becomes so brilliantly luminous that an oar dipped up to the handle can plainly be seen on dark nights by the light so produced; the seat of the phosphorescence is confined to the locomotive rows, and so exceedingly sensitive are they that the slightest shock is sufficient to make them plainly visible by the light emitted from the eight phosphorescent ambulacra." The same author (Op. cit. p. [illegible]) mentions that *Lesueuria* has a very peculiar bluish light of an exceedingly pale steel colour, but very intense. Gegenbaur, again, found that the beautiful riband-like *Cestus* shone with a [illegible] yellow light, but in *Eucharis* the latter was [illegible] (*Op. cit.* p. 495, 496).

While many of the preceding group are pelagic at all periods of their existence, the luminous star-fishes are in their [illegible] condition members of the bottom fauna. The larval stages of the brittle-stars, however, are passed at the surface of the water, where it is probable they add their quota to swell the [illegible] the phosphorescent types. Amongst the first to note [illegible] property in the brittle-stars was Prof. Viviani, who found on the shores of Genoa a little brittle-star which he termed *Asterias noctiluca*,[1] and which probably is identical with the *Am[illegible] elegans* of Leach. Péron likewise mentions the phosphorescence of his *Ophiura phosphorea*. Sir Wyville Thomson observes [illegible] the *Porcupine* that the light from *Ophiacantha spinulosa* was a brilliant green, coruscating from the centre of the disk [illegible] the rays and illuminating the whole outline of the star ("Depths of the Sea," p. 98). More recently Prof. [illegible] of Naples has re-examined the phosphorescence of the [illegible] described by Viviani, and he finds that though with the [illegible] momentary glow the whole ray is lit up with a greenish [illegible] that the luminous points correspond with the bases of the pedicels and are ranged in pairs along the arms (*Atti della Accad. d. Sc. Fisiche e Mathem. di Napoli*, 1875, p. [illegible] figs. 1, 3). In deep water (between twenty and forty fathoms [illegible]) our eastern shores, *Ophiothrix* gleams all over the trawl-net [illegible] a pale greenish light; but the adults of the same form between tide-marks give no trace of luminosity.

The older authors were familiar with certain [illegible] annelids which they termed *Nereides*, such as *Nereis phosphorans*. Ehrenberg paid considerable attention to th[illegible] specially referring to *Polynoe fulgurans* from the [illegible] *Nereis noctiluca*[2] and *Nereis* (*Photocharis*) *cirrigera*, the latter species having a photogenic structure in its cirri like the electric organ of the Torpedo. The latter form is probably related to the ubiquitous *Eusyllis*, which, under various names, has been noticed by many observers. Thus it is very likely the [illegible] species that is mentioned by Harmer, in Baker's "Employment for the Microscope," p. 400, as having been found on oyster [illegible] and also by Vianelli, who describes it as a caterpillar-like [illegible] amongst seaweeds. Indeed the Syllideans have been conspicuous in the literature of phosphorescence from the time of [illegible] Voie (1665, *fide* Panceri), and Vianelli ("Nuove Scoperte [illegible] no le Luci dell' Acqua Marina," Venezia, 1749), to the [illegible] period of Claparède ("Glanures Zootomiques," p. [illegible]) Panceri (*Op. cit.* p. 8). The structure of the cirri of the phosphorescent forms, however, gives no support to the opinion of Ehrenberg that they possess a special photogenic structure.

The luminous annelids group themselves under five families, viz. the Polynoidæ, Syllidæ, Chætopteridæ, Terebellidæ, [illegible] Tomopteridæ, and the number may yet be extended to include other pelagic types.

In the first family one of the most abundant is *Harmothoe imbricata*, which lives both between tide-marks and deep [illegible] and is cosmopolitan in geographical distribution. It discharges bright greenish scintillations from the point of attachment of [illegible] dorsal scale; and thus, und[illegible] the flashes are [illegible] in pairs along the body, [illegible] moniliform [illegible] severely pinched the worm [illegible] the water, [illegible] sparks of green light from [illegible] scales also continue to glea[illegible] faces of attachment (scars), [illegible]

[illegible] The same phenomenon [illegible] the anterior or posterio[illegible] [illegible]itted, but the light is [illegible] and by the agency [illegible] Dr. Jourdan (*Zoologi*[illegible] [illegible] 133), has endeavo[illegible] [illegible]ber of the Pol[illegible] [illegible]

B[illegible] family [illegible] *Achloe a*[illegible]

[1] "Phospho[illegible] observes: "Sp[illegible] excitasse, quas el[illegible]

[2] Supposed by so[illegible]

As an example of the Syllidæ, the common *Eusyllis*, so often mentioned by previous authors, may be taken. Under irritation a fine green light is emitted from the ventral aspect of each foot, and the scintillations seem to issue from many points at each space, flash along both sides of the worm posterior to the point of stimulation, and then disappear. Under severe irritation the animal remains luminous behind the injured part for nearly half a minute, while the surface of granular light on each segment is larger than usual, and in some instances those of opposite sides are connected on the ventral aspect by a few phosphorescent points. The body behind the irritated region has a paler pinkish hue immediately after the emission of light showing that the luminosity is diffused.

In the Chætopteridæ the phosphorescence is remarkably beautiful, bright flashes being emitted from the posterior feet; but the most vivid luminosity is at a point on the dorsum between the lateral wings of the tenth segment. Here the abundant mucus exuded by the animal can be drawn out as bluish-purple fire of great intensity, which, besides, now and then gleams along the edges of the wing-like processes, and illuminates the surrounding water. A very characteristic odour, somewhat resembling that produced by phosphorus in combustion, is given out by the animal during such experiments. In this connection it may be observed that Quoy and Gaimard mention that an odour similar to that around an electric machine is given out by luminous marine annelids.

Amongst the Terebellidæ, as first shown by Grube none excel the genus *Polycirrus* in the brightness of the phosphorescence and the ease with which it is elicited. Mere blowing on the water of the dissecting-trough suffices to cause in the British *Polycirrus* the most vivid pale bluish luminosity, which gleams for a moment along every one of the independent mobile tentacles. Long before Grube, however, had discovered the phosphorescence of *Polycirrus*, our patient and laborious countryman, Sir J. Graham Dalyell, had noticed it in the group ("Powers of the Creator," vol. ii. p. 210), for he mentions that when irritated *Terebella figulus* gave out the most copious blue refulgence, intermingled with a reddish flame. Another member of this family, viz. *Thelepus*, is only faintly phosphorescent in life, but when decomposition has made progress it gleams in the vessel with a pale lambent light, somewhat like phosphorus in air.

In the pelagic Tomopteridæ certain peculiar structures on the parapodia, formerly supposed by some to be eyes, and by others simply glandular organs, were lately found by Professor Greeff (*Zoologischer Anzeiger*, 1882, p. 384—87) to be luminous organs, which, though glandular, have a considerable nervous supply, including a ganglion.

Panceri's observations on the luminous annelids of Naples, and the peculiar type *Balanoglossus* (Enteropneusta) have recently added considerably to our knowledge of the subject. He specially describes, in *Chætopterus*, the structure of the phosphorescent glands in the great pinnules and other parts, which produce the luminous mucus. With some reason he concludes that two kinds of phosphorescence are present in annelids, viz., one which is the result of purely nervous action, and another which is due to this *plus* a luminous secretion.

A Turbellarian, viz., *Planaria retusa*, was mentioned by Viviani (*Op. cit.* p. 13) as luminous, but this feature appears to be rare in the group; and the same may be observed of phosphorescent Rotifers, one of which (*Synchæta baltica*) was described by Ehrenberg (*Op. cit.* p. 128). Giglioli (*Op. cit.* p. 498) again, records a *Sagitta* which showed a feeble luminosity in the posterior region of the body.

Th[illegible]ite forms amongst the Crustacea (chiefly Copepoda) we[illegible]d as phosphorescent by Athanasius Kircher in 1640, and [illegible]ntioned by most authors who have alluded to the [illegible]ute. Thus Viviani gives seven species from [illegible]nd Tilesius no less than nineteen luminous [illegible]stern's voyage. Dr. Baird describes the [illegible]et with in his cruises as brilliant in the [illegible]mpson added considerably to our [illegible] of the luminous schizopods, an [illegible]ered by Sir Joseph Banks, and [illegible] 1810, as "Cancer fulgens"). [illegible] such as the Copepods, [illegible]ce of the water. The [illegible] from glands placed [illegible]nd the luminous [illegible]rior part of the [illegible] *Euplectella*,

&c., 1878) thought it was decomposing food in the stomach, and Prof. Moseley (*Op. cit.* p. 574.—Naturalist on the *Challenger*) in certain cases entertained a similar opinion. The phosphorescence of the Euphausiidæ was a prominent feature in the voyage of the *Challenger*, brilliant flashes being emitted on capture from a series of spots along the trunk and tail. Mr. Murray also met with a diffused light in the Faröe channel when dredging in the *Triton*, and he attributed this to the phosphorescent organs of *Nyctiphanes norvegica*, M. Sars, one of the same group. Prof. G. O. Sars describes these organs as composed of a series of coloured globules, the lens-like body of which acts as a condenser, and thus enables the animal to produce at will a bright flash of light in a given direction ("*Challenger* Narrative," Zoology, I. part ii. pp. 740—43).

Marine phosphorescence has some of its most striking examples amongst the Tunicates. One of the best known instances is that of *Pyrosoma*, the light from which has been so graphically described by M. Péron, Prof. Huxley, and other naturalists who have had an opportunity of observing it. It proceeds in each member of the compound organism from two small patches of cells at the base of each inhalent tube. These cells contain a substance resembling fat. *Salpa* has frequently been mentioned as a luminous form by many authors, but Delle Chiaje found that in the Mediterranean *Salpa pinnata* was not phosphorescent; and amongst the multitudes of Salpæ which for some weeks abounded at Lochmaddy in North Uist, neither the former nor the *Salpa spinosa* of Otto exhibited this property, though a spark was occasionally seen in the nucleus in some specimens, probably from the food. Giglioli likewise is doubtful concerning them, but in one instance a brilliant rose-coloured light appeared in the nucleus. *Doliolum*, on the other hand, shone with a greenish tint, while examples of *Appendicularia* which he encountered in various seas were chameleon-like in their luminosity, and often gleamed with great brightness.

Various mollusks exhibit the property of phosphorescence. Fabricius ab Aquapendente mentions *Sepia*, Panceri *Eledone*, Adler *Chama* and "*Dactylus*." The best known, however, is *Pholas dactylus*, which possesses two wavy bands and triangular organs of ciliated epithelium on the inner surface of the mantle. These secrete a luminous substance, soluble in ether and alcohol, which light up the excurrent water. The light is also maintained for a long time during putrefaction, as in the case of *Thelepus*. Panceri found that carbonic acid extinguished the light, but that air re-illuminated it, just as Johannes Müller had previously observed in a vacuum and in air. The light is monochromatic, the bands having a constant place in connection with the solar spectrum (from line E to line F).

Several Pteropods likewise contribute to the phosphorescence of the sea. Thus Giglioli noticed that a *Cleodora* gave out a very reddish light, while a *Criseis* and a *Hyalæa* were luminous at the base of the shell. He mentions also a large unknown Heteropod (*Op. cit.* p. 497) in the Indian Ocean, which glowed with a reddish phosphorescence. Amongst the Dermatobranchs, *Phyllirrhoë* has the same property, Giglioli further found that *Loligo sagittatus* and a small *Octopus* gleamed all over with a whitish luminosity.

Phosphorescence in living fishes appears to have been accurately observed within a comparatively recent date, though the luminosity of dead fishes has been known from very early times, and has been the subject of many interesting experiments such as those of Robert Boyle on dead whitings (*Phil. Trans.* 1667, pp. 591-93), and Dr. Hulme on herrings (*Phil. Trans.* 1800, p. 161). I do not mean to say that the literature of the so-called phosphorescent fishes is scanty, for it extends from the days of Aristotle and Pliny to modern times, but that the writers have had little reliable evidence in regard to living fishes to bring forward. Thus of upwards of fifty fishes entered by Ehrenberg in his list it is hard to say that one is really luminous during life. In many cases it is probable that the supposed phosphorescence of large forms, such as sword-fishes and sharks, has arisen from the presence of multitudes of minute phosphorescent animals in the water, just as the herring causes a gleam when it darts from the side of a ship. Prof. Moseley, for instance, observed in the *Challenger* that when large fishes, porpoises, and penguins dashed through phosphorescent water, that it was brilliantly lit up, and their track marked by a trail of light. The same feature is observed in hooked fishes, and it is known that fishermen are doubtful of success when the sea is very phosphorescent, for the presence of the net in the water excites the luminosity and scares the herring.

One of the most striking instances of phosphorescence in living fishes is that of the luminous shark (*Squalus fulgens*) found by Dr. Bennett. This is a small dark-coloured shark, which was captured on two or three occasions at the surface of the sea It emitted without irritation a vivid greenish luminosity as it swam about at night, and it shone for some hours after death. The phosphorescence appears to be due to a peculiar secretion of the skin. The eyes of the shark were more prominent than usual in such forms. (The Danish naturalist Reinwardt describes a phosphorescent fish (*Hemiramphus lucens*) from the Moluccas. *Fide* Giglioli, *Op. cit.* p. 503.) Little is known with regard to the luminosity of the "Pearl-sides" (*Maurolicus pennantii*, Cuv. and Val.) of our own shores, though from its wide distribution this lack of information seems to be remediable.

In recent times phosphorescence has generally been associated with deep-sea fishes. Thus in a narrative of the early part of the voyage of the *Challenger* (NATURE, August 28, 1873) Sir Wyville Thomson mentions ranges of spots or glands producing a phosphorescent secretion on the body of a fish pertaining to the Sternoptychidæ, a species of which is included by Dr. F. Day in the British list. Of a new *Echiostoma* (one of the Stomiatidæ) it is also noted that the two rows of probably phosphorescent dots along the body were red, surrounded by a circle of pale violet ("*Challenger* Narrative, Zoology," I. vol. ii. p. 42). Dr. Gunther ("*Challenger* Narrative, Zoology, I. part ii. p. 905) observes that many deep-sea fishes have round, shining, mother-of-pearl bodies embedded in the skin. These are supposed to be producers of light, and they have been observed to be phosphorescent in two species of Sternoptychidæ. He further states that the whole muciferous system is dilated in deep-sea fishes, that is, fishes inhabiting 1000 fathoms or more, and that the entire body seems to be covered with a layer of mucus, the physiological use of which is unknown; it has been noticed to have phosphorescent properties in perfectly fresh specimens.

Having thus briefly reviewed the leading features of phosphorescence in marine animals, a glance may now be taken at the supposed causes and purposes of this provision.

I do not deem it necessary to go into detail with regard to the numerous views which have been advanced to account for the phosphorescence of marine organisms, for these range over a very wide area—from its production by electricity, the constant agitation of the water, by putrefaction, by luminous imbibition, to its manifestation as a vital action in the animals, or a secretion of a phosphorescent substance. Ehrenberg considered it a vital act similar to the development of electricity, and sometimes accompanied by the secretion of a mucilaginous humour which is diffused around; while others, such as Meyen, thought it only a superficial oxidation of the mucous coat, or a luminour secretion from certain glands. Some believed that a liquid containing phosphorus was secreted, and that this underwent slow combustion; while others explained that it was a nervous fluid modified by certain organs to appear as light. Coldstream thought it was due to an imponderable agent, and that phosphorus or an analogous substance might enter into the organs producing it. De Quatrefages, again, clearly affirms that it is produced in two ways: (1) by the secretion of a peculiar substance exuding from the entire body or a special organ; and (2) by a vital action independent of all material secretion. Panceri was strongly impressed with the importance of fatty matter in the forms he examined—such as *Pennatula*, the Medusæ, Beroides, Pholades, *Chætopteri*, and *Noctilucæ*—the phosphorescence arising from the slow oxidation of this substance; the nervous system of the living animal, however, being capable of producing a momentary oxidation more rapid and more intense, accompanied by light.

It will be observed that in the Protozoa the structure of the minute but often very abundant animals which furnish the luminosity clearly proves that the presence of a well-defined nervous system is not required for its manifestation, the protoplasm of their bodies alone sufficing for its development. There are neither glands for secreting it, and in some apparently no fatty matter for slow combustion. In the Cœlenterates the phenomena appear to be more nearly related to nervous manifestations, though in certain cases the luminous matter possesses inherent properties of its own. While in some annelids, such as *Chætopterus* and *Polycirrus*, there are glands which may be charged with the secretion of a luminous substance, it is otherwise with certain Polynoidæ, in which the emission of light appears to be an inherent property of the nervous system. The irritability in the phosphorescent examples of the latter family, however, varies considerably, some, *e.g. Polynoe scolopendrina*, being sluggish, while others, like *Harmothoe*, are extremely irritable. In the Crustaceans the luminosity seems to have the nature of a secretion, probably under the control of the nervous system. In *Pyrosoma* and *Pholas dactylus* a luminous secretion is also a prominent feature, and in both the latter and the annelids decay excites its appearance, as also is the case, to a limited extent, in fishes.

It is evident, therefore, that the causation of phosphorescence is complex. In the one group of animals it is due to the production of a substance which can be left behind as a luminous trail. The ease, for instance, with which in *Pennatula* and other Cœlenterates the phosphorescence can be repeatedly produced by friction on a surface having a minute trace of the material clearly points to other causes than nervous agency. The action, moreover, clearly affects the organic chemical affinities of the tissues engaged. On the other hand again, as in certain annelids, it is purely a nervous action, probably resembling that which gives rise to heat.

With the exception of such as Macartney, the older authors, who in some cases took an imaginative view of the question, connected the emission of light with the special economy of the deep sea. The speculations to this effect are fairly summarised in "Brewster's Edinburgh Encyclopædia," published in 1830 (Chiefly the views of Dr. Macculloch). Thus it is supposed that total darkness exists at the depth of 1000 feet, and that the phosphorescence of marine animals is a substitute for the light of the sun. Moreover, that by these lights the animals on the one hand are guided for attack, and on the other their power of extinguishing them enables them to escape destruction. Fishes are known to prey chiefly at night, and the writer supposes that the phosphorescence of their prey guides them; for, he says, this luminosity is particularly brilliant in those inferior animals which from their astonishing powers of reprodnction, and from a state of feeling little superior to that of vegetables, appear to have been in a great measure created for the food of the more perfect kinds. Dr. Coldstream at a later period (1847) reproduced the same views in his article on animal luminosity (Todd's "Cyclop. of Anat. and Phys.").

The same notion was brought forward in the "Report of the Cruise of the *Porcupine*" (*Proc. Roy. Soc.*, No. 121, 1870, p. 432), and special reference was made to the young of certain starfishes, which are stated to be more luminous than the adults, that being part of the general plan which provides an excess of the young of many species, apparently as a supply of food, their wholesale destruction being necessary for the due restriction of the multiplication of the species, while the parent individuals, on the other hand, are provided with special appliances for escape or defence. Thus phosphorescence, it is further asserted ("Depths of the Sea," p. 149), in very young Ophiacanthæ just rid of their plutei, in a sea swarming with predaceous crustaceans, such as *Dorynchus* and *Munida*, with great bright eyes, must be a fatal gift. Some naturalists still appear to hold a similar, though perhaps modified view. Much caution, however, is necessary in theorising on this head.

In the first place, phosphorescent animals do not appear to be more abundant in the depths of the sea than between tide-marks or on the surface, the latter perhaps presenting the maximum development of those exhibiting this phenomenon. Very many of the young that have been indicated as so brilliantly luminous become surface-forms soon after leaving the egg, and thus at their several stages more or less affect the three regions—surface, mid-water, and bottom.

A survey of the life-histories of the several phosphorescent groups affords at present no reliable data for the foundation of a theory as to the functions of luminosity, especially in relation to food. No phosphorescent form is more generally devoured by fishes or other animals than that which is not; and, on the other hand, the possessor of luminosity, if otherwise palatable, does not seem to escape capture. An examination of the stomachs of fishes makes this clear, except perhaps in the case of the herring, which, however, is chiefly a surface-fish. Further, it is not evident that su[illegible] luminous at all times, for it is only under [illegible] exhibit the phenomenon.

Moreover, the irregulari[illegible] sessing the same structure [illegible] the vie[illegible]ssed. T[illegible] kn[illegible] of Ph[illegible] P[illegible] eit[illegible] between tide-marks (*Harmothoë imbricata* and *Polynoë floccosa*), and closely resemble each other in habits and appearance; yet one is brightly luminous, while the other shows no trace. Instead of luring animals for prey, or affording facilities for being easily preyed upon, the possessors of phosphorescence in the annelids are often the inhabitants of tubes, or are commensalistic on starfishes. Indeed, every variety of condition accompanies the presence of phosphorescence in the several groups, so that the greatest care is necessary in making deductions, especially if these are to have a wide application.

In the foregoing brief outline of the remarkable phenomenon of phosphorescence as it affects marine animals, it is apparent that, though a considerable increase in our knowledge has taken place during the last quarter of a century, much more yet remains to be done. I, however, confidently look forward for further advances, in this as well as in other departments, to the marine laboratories of the country—I mean such institutions as those now in working order at Granton, St. Andrews, and Tarbet, as well as the larger establishment proposed to be erected by the Biological Association at Plymouth. These laboratories, it is true, have been tardily instituted, but it is satisfactory to think that at last the zeal and methods of the workers have, and will have, a better field for their exercise than formerly, and that the zoology of the fisheries will obtain that attention which its importance to the country necessitates.

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## SECTION E.

### GEOGRAPHY.

OPENING ADDRESS BY GENERAL J. T. WALKER, C.B., LL.D., F.R.S., F.R.G.S., PRESIDENT OF THE SECTION.

MY predecessors in this chair have claimed for geography a range of science which may be said to be practically unlimited; for it comprehends the history of the earth itself, and of all the life to be met with on the surface of the earth, from the first beginnings of things, and through their subsequent development onwards to their present conditional status; it is associated in a greater or less degree with every other department of knowledge and is a remarkable exemplification of the mutual interdependence and correlation of the physical sciences, for while all other branches of science are incomplete without some knowledge of geography, it is incomplete without some knowledge of each and all of them.

Such claims on behalf of geography would, not many years ago, have been considered extravagant and exaggerated; a popular encyclopædia which is still of some note defines geography to be simply the science which describes the surface of the earth, and somewhat querulously complains that geographical treatises contain matter not unfrequently taken from statistics, natural philosophy, and history which it declares to be irrelevant and not properly admissible into such treatises. And in a popular sense geography is still commonly suggestive only of such a knowledge of locality as may be acquired from maps and charts, with their graphical delineations of whatever exists on the surface of the earth, and of the various natural or artificial boundary lines of the peoples and states between whom the surface is divided. But the British Association and the Royal Geographical Society have successfully maintained that scientific geography is not restricted in its scope to a mere knowledge of locality—though that in itself is a very important factor in whatever appertains to the intercourse and mutual relations of mankind—but embraces all that relates to the structure and existing configuration of the earth, and takes cognisance of the varied conditions of all the life, both animal and vegetable, which is nurtured and supported by the earth; it studies the side lights which the general configuration of surface throws on the character of each locality as a home and support of life, and it examines with special interest the influence which that character has exerted on the social and political conditions of different races and peoples.

And [illegible] does not merely devote its attention to the [illegible] as now displayed to our gaze; in alliance [illegible] history of a distant past, when the [illegible] were not precisely as now, and lands [illegible] lay deep beneath the ocean, [illegible] mute records we possess in [illegible] as they are signific- [illegible]—which, after long lying entombed among the rocks, are presented to modern sight as revelations of life's early dawn; it investigates what Baron Richtofen describes as the reciprocal causal relations of the three kingdoms—land, water, and atmosphere; it seeks to determine the processes by which in some parts of the globe continents were built up with their varied sculpture of mountain and valley, of highly elevated plateau and low lying plain, of lakes and inland seas, and great river systems,—while in other parts land was depressed below the sea level, or broken up into the islands which are now dotting the surface of the ocean; and it endeavours to trace a process of continuous evolution of life from the primary and simplest types which perished in the early ages of the earth's history, to the latest and most highly developed types which are now flourishing around us. Going back still further it searches for evidence of the first beginnings of the material universe; it looks beyond the orbit of the most distant planet of the solar system, and scrutinises the boundless regions of stellar space to find, in the widely scattered particles of the nebulæ, the beginnings of new solar systems and new worlds such as ours; there it may be said to behold as in a mirror the formation of our own planet as a fluid igneous mass thrown off with great velocity from its sun, and rapidly revolving, and then becoming spheroidal, and slowly cooling and solidifying, and finally acquiring the crust which was to become an abode for life, the stage whereon man was to play out the drama of his planetary existence, and be held all the while fast imprisoned and out of touch with the surrounding universe.

More than this we would seek to know, but in vain; in passing from the early dawn of matter to that of life, science finds its career of wonderful achievement in the one direction exchanged for failure and disappointment in the other; it cannot discover the origin of life in any of its existing material forms, nor trace to its birthplace the spiritual life which exerts such an influence on what is material; it cannot ascertain whether man had a prior existence as different from his present existence as the first beginnings of his planet home differed from its present condition; it cannot gauge the truth of the poet's prescient conception that

> "Our birth is but a sleep and a forgetting;
> The soul that rises with us, our life's star,
> Hath had elsewhere its setting
> And cometh from afar."

It whispers faint suggestions regarding the possible future of the planet; but when questioned as to what is to follow the coming soul's setting of man, the planet's chief glory and dignity, it has nothing to reply, but is hopelessly dumb and inarticulate.

Scientific geography embraces a wide range of subjects, wider than can be claimed for any other department of science. Thus the President of this Section has a vast field from which to gather subjects for his opening address. I shall, however, restrict my address to the subject with which I am most familiar, and give you some account of the Survey of India, and more particularly of the labours of the trigonometrical or geodetic branch of that survey, in which the best years of my life have been passed.

I must begin by pointing out that the survey operations in India have been very varied in nature, and constitute a blending together of many diverse ingredients. Their origin was purely European, nothing in the shape of a general survey having been executed under the previous Asiatic Governments; lands had been measured in certain localities, but merely with a view to acquiring some idea of the relative areas of properties, in assessing on individuals the share of the revenue levied on a community; but other factors than area—such as richness or poverty of soil, and proximity or absence of water—influenced the assessment, and often in a greater degree, so that very exact measurements of area were not wanted for revenue purposes, and no other reason then suggested itself why lands should be accurately measured. The value of accurate maps of individual properties, with every boundary clearly and exactly laid down, was not thought of in India in those days, and indeed has only of late years begun to be recognised by even the British Government. The idea of a general geographical survey never suggested itself to the Asiatic mind. Thus when Englishmen came to settle in India, one of their first acts was to make surveys of the tracts of country over which their influence was extending; and as that influence increased, so the survey became developed from a rude and rapid primary delineation of the broad facts of general geography, to an elaborately executed and artistic delineation of the topography of the country, and in some provinces to the mapping of every field and individual property. Thus there have been three orders or classes of survey, and these may be respectively designated geographical, topographical, and cadastral; all three have frequently been carried on *pari passu*, but in different regions, demanding more or less elaborate survey according as they happened to be more or less under British influence. There is also the Great Trigonometrical or Geodetic Survey, by which the graphical surveys are controlled, collated, and co-ordinated, as I will presently explain.

Survey operations in India began along the coast-lines before the commencement of the seventeenth century, the sailors preceding the land surveyors by upwards of a century. The Directors of the East India Company, recognising the importance of correct geographical information for their mercantile enterprises, appointed Richard Hakluyt, Archdeacon of Westminster, their historiographer and custodian of the journals of East Indian voyages, in the year 1601, within a few weeks of the establishment of the company by Royal Charter. Hakluyt gave lectures to the students at Oxford, and is said by Fuller to have been the first to exhibit the old and imperfect maps and the new and revised maps for comparison in the common schools, "to the singular pleasure and great contentment of his auditory." The first general map of India was published in 1752 by the celebrated French geographer D'Anville, and was a meritorious compilation from the existing charts of coast-lines and itineraries of travellers. But the Father of Indian Geography, as he has been called, was Major Rennell, who landed in India as a midshipman of the Royal Navy in 1760, distinguished himself in the blockade of Pondicherry, was employed for a time in making surveys of the coast between the Paumben Passage and Calcutta, was appointed Surveyor of the East India Company's dominions in Bengal in 1764, was one of the first officers to receive a commission in the Bengal Engineers on its formation, and in 1767 was raised to the position of Surveyor-General. Bengal was not in those days the tranquil country we have known it for so many years, but was infested by numerous bands of brigands who professed to be religious devotees, and with whom Rennell came into collision in the course of one of his surveying expeditions, and was desperately wounded; he had to be taken 300 miles in an open boat for medical assistance, the natives meanwhile applying onions to his wounds as a cataplasm. His labours in the survey of Bengal lasted over a period of nineteen years, and embraced an area of about 300,000 square miles, extending from the eastern boundaries of Lower Bengal to Agra, and from the Himalayas to the borders of Baudelkand and Chota Nagpur. Ill-health then compelled him to retire from the service on a small pension and return to England; but not caring, as he said, to eat the bread of idleness, he immediately set himself to the utilisation of the large mass of geographical materials laid up and perishing in what was then called the India House; he published numerous charts and maps, and eventually brought out his great work on Indian Geography, the "Memoir of a map of Hindostan," which went through several editions; this was followed by his Geographical System of Herodotus, and various other works of interest and importance. His labours in England extended over a period of thirty-five years, and their great merits have been universally acknowledged.

Rennell's system of field-work in Bengal was a survey of routes checked and combined by astronomical determinations of the latitude and the longitude, and a similar system was adopted in all other parts of India until the commencement of the present century. But in course of time the astronomical basis was found to be inadequate to the requirements of a general survey of all India, as the errors in the astronomical observations were liable materially to exceed those of the survey, if executed with fairly good instruments and moderate care. Now this was no new discovery, for already early in the eighteenth century the French Jesuits who were making a survey of China—with the hope of securing the protection of the Emperor, which they considered necessary to favour the progress of Christianity—had deliberately abandoned the astronomical method and employed triangulation instead. Writing in the name of the missionaries who were associated with him in the survey, Père Regis enters fully into the relative advantages of the two methods, and gives the trigonometrical the preference, as best suited to enable the work to be executed in a manner worthy the trust [illegible] by a wise prince, who judged it of the great[illegible] State. "Thus," he says, "we flatter our[illegible] the surest course, and even the only one practicable in prosecut[illegible] the greatest geographical work that was ever performed accord[illegible] to the rules of art."

What was true in those days is true still; points who[illegible] relative positions have been fixed by any triangulation of mod[illegible] rate accuracy present a more satisfactory and reliable basis [illegible] topographical survey than points fixed astronomically. Thou[illegible] the lunar theory has been greatly developed since those days [illegible] the labours of eminent mathematicians, and the accuracy of th[illegible] lunar tables and star catalogues is much increased, absol[illegible] longitudes are still not susceptible of ready determination [illegible] great exactitude; moreover, all astronomical observations, whe[illegible] of latitude or longitude, are liable to other than intrinsic err[illegible] which arise from deflection of the plumb-line under the influe[illegible] of local attractions, and which of themselves materially exc[illegible] the errors that would be generated in any fairly exec[illegible] triangulation of a not excessive length, say not exceeding [illegible] miles.

Thus at the close of the last century Major Lambton, of [illegible] 33rd Regiment, drew up a project for a general triangulation [illegible] Southern India. It was strongly supported by his command[illegible] officer—Colonel Wellesley, afterwards the Duke of Welling[illegible] —and was readily sanctioned by the Madras Government, [illegible] large accession of territory in the centre of the peninsula [illegible] been recently acquired, as the result of the Mysore campa[illegible] by which free communication had been opened between the [illegible] and west coasts of Coromandel and Malabar; and the pro[illegible] triangulation would not merely furnish a basis for new surv[illegible] but connect together various isolated surveys which had alre[illegible] been completed or were then in progress. The Great Trig[illegible] metrical Survey of India owes its origin as such, and its s[illegible] taneous inception as a geodetic survey, to Major Lambton, [illegible] pointed out that the trigonometrical stations must needs [illegible] their latitudes and longitudes determined for future refere[illegible] just as the discarded astronomical stations, not however by d[illegible] observation, but by processes of calculation requiring a kn[illegible] ledge of the earth's figure and dimensions. But at that time [illegible] elements of the earth's figure were not known with much exa[illegible] tude, for all the best geodetic arcs had been measured in h[illegible] latitudes, the single short and somewhat questionable ar[illegible] Peru being the only one situated in the vicinity of the equa[illegible] Thus additional arcs in low latitudes, as those of India, we[illegible] greatly needed and might be furnished by Lambton. He t[illegible] care to set this forth very distinctly in the programme which [illegible] drew up for the consideration of the Madras Governmen[illegible] remarking that there was thus something still left as a desid[illegible] tum for the science of geodesy, which his operations m[illegible] supply, and that he would rejoice indeed should it come w[illegible] his province "to make observations tending to elucidate [illegible] sublime a subject."

Lambton commenced operations by measuring a base line [illegible] a small meridional arc near Madras, and then, casting a se[illegible] triangles over the southern peninsula, he converted the triang[illegible] on the central meridian into a portion of what is now known [illegible] the Great Arc of India, measuring its angles with extreme car[illegible] and checking the triangulation by base lines measured at distance[illegible] of two to three degrees apart in latitude. His principal instr[illegible] ments were a steel measuring chain, a great theodolite, and [illegible] zenith sector, each of which had a history of its own befo[illegible] coming into his hands. The chain and zenith sector were se[illegible] from England with Lord Macartney's Embassy to the Empe[illegible] of China, as gifts for presentation to that potentate, who [illegible] fortunately did not appreciate their value and declined to accep[illegible] them; they were then made over to Dr. Dinwiddie, the astronomer to the embassy, who took them to India for [illegible] The theodolite was constructed in England for Lambton [illegible] use on the Ordnance Survey; on its p[illegible] was captured by the French frigate, the [illegible] Mauritius, but eventually it was forwar[illegible] French Governor, De C[illegible] the Governor of Madras.

[illegible] assisted for a short time [illegible] known in connec[illegible] of the [illegible] of demonstrating the astronomical method to be fallacious, for its determination of the breadth of the peninsula in the latitude of Madras was proved by the triangulation to be forty miles in error. Still, for several years he never received a word of sympathy, encouragement, or advice either from the Government or from the Royal Society. A foreign nation was the first to recognise the importance of his services to science, the French Institute electing him a corresponding member in 1817. After this, honours and applause quickly followed from his own countrymen. In 1818 the Governor-General of India—then the Marquis of Hastings—decided that the survey should be withdrawn from the supervision of a local Government and placed under the Supreme Government, with a view to its extension over all India, remarking at the same time that he was "not aware that with minds of a certain order he might lay himself open to the idle imputation of vainly seeking to partake the gale of public favour and applause which the labours of Colonel Lambton had recently attracted;" but as the survey had reached the northern limits of the Madras Presidency, its transfer to the Supreme Government, if it was to be further extended, had become a necessity. He directed the transfer to be made, and the survey to be called in future the Great Trigonometrical Survey of India. Noticing that the intense mental and bodily labour of conducting it was being performed by Lambton alone, that his rank and advancing age demanded some relief from such severe fatigue, and farther, that it was not right that an undertaking of such importance should hang on the life of a single individual, the Governor-General appointed two officers to assist him—Captain Everest, as chief assistant in the geodetic operations; and Dr. Voysey, as surgeon and geologist. Five years afterwards Lambton died, at the age of seventy. The happy possessor of an unusually robust and energetic constitution and a genial temperament, he seems to have scarcely known a day's illness, though he never spared himself nor shrank from subjecting himself to privations and exposure which even Everest thought reckless and unjustifiable. These he accepted as a matter of course, saying little about them, and devoting his life calmly and unostentatiously to the interests of science and the service of his country.

Everest's career in the survey commenced disastrously. He was deputed by Lambton to carry a triangulation from Hydrabad, in the Nizam's territory, eastwards to the coast, crossing the forest-clad and fever-haunted basin of the Godavery river, a region which he described as "a dreadful wilderness, than which no part of the earth was more dreary, desolate, and fatal." Indignant at being taken there, his escort, a detachment of the Nizam's troops, mutinied, and soon afterwards he and his assistants, and almost all the men of his native establishment, were stricken down by a malignant fever; many died on the spot, and the survivors had to be carried into Hydrabad, whence litters and vehicles of all descriptions, and the whole of the public elephants, were despatched to their succour. To recover his health Everest was compelled to leave India for a while and proceed to the Cape of Good Hope, where he remained for three years. He availed himself of the opportunity to inspect Lacaille's meridional arc, which, when compared with the arcs north of the equator, indicated that the opposite hemispheres of the globe were seemingly of different ellipticities. He succeeded in tracing this anomaly to an error in the astronomical amplitude of the arc, which had been caused by deflection of the plumb-line at the ends of the arc, under the influence of the attraction of neighbouring mountains. Thus he became aware of the necessity of placing the astronomical stations of the Indian arcs at points where the plumb-line would not be liable to material deflection by the attraction of neighbouring mountain ranges. Shortly after his return to India Lambton died, and Everest succeeded him, and immediately concentrated his energies on [illegible] extension of the Great Arc northwards. He soon came to [illegible] conclusion that his instrumental equipment, though good for [illegible] time when it was procured, and amply sufficient for ordinary [illegible] purposes, was inadequate for the requirements of [illegible] generally inferior to the equipments of the geodetic [illegible] progress in Europe. He therefore proceeded to [illegible] the procedure of the English and French surveys, [illegible] supply of new instruments of the latest and [illegible] the Court of Directors of the Honourable [illegible] a most liberal assent to all his [illegible] *blanche* to provide himself with [illegible] satisfy all the requirements [illegible] instrumental equipment

in 1830, a year that marks the transition of the character of the operations from an order of accuracy which was sufficient as a basis for the graphical delineation of a comparatively small portion of the earth's surface, to the higher precision and refinement which modern geodesists have deemed essentially necessary for the determination of the figure and dimensions of the earth as a whole. He immediately introduced an important modification of the general design of the principal triangulation, which up to that time had been thrown as a network over the country on either side of the Great Arc, as in the English survey and many others; but he abandoned this method, and, adopting that of the French survey instead, he devised a system of meridianal chains to be carried at intervals of about 1° apart, and tied together by longitudinal chains at intervals of about 5°, the whole forming, from its resemblance to the homely culinary utensil with which we are all familiar, what has been called the gridiron system in contradistinction to the network. The entire triangulation was to rest on base-lines to be measured with the new Colby apparatus of compensation bars and microscopes which had been constructed to supersede the measuring chain the Emperor of China had rejected; the base-lines were to be placed at the intersections of the longitudinal chains of triangles with the central meridional or axial chain, and also at the further angles of the gridirons on each side. Latitudes were to be measured at certain of the stations of the central chain, with new astronomical circles in place of the old zenith sector, to give the required meridional arcs of amplitude. Two radical improvements on all previous procedure were introduced in the measurement of the principal angles, one affecting the observations, the other the objects observed. The great theodolites were manipulated in such a manner as not merely to reduce the effects of accidental errors by numerous repetitions in the usual way, but absolutely to eliminate all periodic errors of graduation by systematic changes of the position of the azimuthal circle relatively to the telescope, in the course of the complete series of measures of every angle. The objects formerly observed had been cairns of stones or other opaque signals; for these Everest substituted luminous signals, lamps by night, and, by day, heliotropes which were manipulated to reflect the sun's rays through diaphragms of small aperture, in pencils appearing like bright stars, and capable of penetrating a dense atmosphere through which distant opaque objects could not be seen.

Everest's programme of procedure furnished the guiding principles on which the operations were carried out during the period of half a century which intervened between their commencement under his superintendence and the completion of the principal triangulation under myself. The external chains have necessarily been taken along the winding course of the frontier and coast lines instead of the direct and more symmetrical lines of the meridians and the parallels of latitude. The number of the internal meridional chains has latterly been diminished by widening the spaces between them, and in two instances a principal chain has been dispensed with because, before it could be taken in hand, a good secondary triangulation had been carried over the area for which it was intended to provide. But these are departures from the letter rather than the spirit of Everest's programme which has been faithfully followed throughout, first by his immediate successor, Sir Andrew Waugh, and afterwards by myself, thus affording an instance of the impress of a single mind on the work of half a century which is probably unique in the annals of India; for there, as is well known, changes of personal administration are frequent, and are not uncommonly followed by changes of procedure.

The physical features of a country necessarily exercise a considerable influence on the operations of any survey that may be carried over it, and more particularly on those of a geodetic survey, of which no portion is allowed to fall below a certain standard of precision. Every variety of feature, of scenery, and of climate that is to be met with anywhere on the earth's surface between the equator and the arctic regions has its analogue between the highlands of Central Asia and the ocean, which define the limits of the area covered by the Indian survey. Thus in some parts the operations were accomplished with ease, celerity, and enjoyment, while in others they were very difficult and slow of progress, always entailing great exposure, and at times very deadly. In an open country, dotted with hills and commanding eminences, they advanced as on velvet; in close country, forest-clad or covered with other obstacles to distant vision, they were greatly retarded, for there it became necessary either to raise the stations to a sufficient height to overlook all surrounding obstacles, or to render them mutually visible by clearing the lines between them; and both these processes are more or less tedious and costly. There are many tracts of forest and jungle which greatly impeded the operations, not merely because of the physical difficulties they presented, but because they teemed with malaria, and were very deadly during the greater portion of the year, and more particularly immediately after the rainy seasons, when the atmosphere is usually clearest and most favourable for distant observations. At first tracts of forest, covering extensive plains, were considered impracticable; thus Lambton carried his network over the open country, and stopped it whenever it reached a great plain covered with forest and devoid of hills; but Everest's system would not permit of any break of continuity, nor the abandonment of any chain which was required to complete a gridiron; it has been carried out in all its integrity, often with much sacrifice of life, but never with any shrinking on the part of the survey officers from carrying out what it had become a point of honour with them to accomplish, and the accomplishment of which the Government had come to regard as a matter of course. We have already seen how the progress of Everest's first chain of triangles was suddenly arrested because he and all his people were struck down by malaria in the pestilential regions of the Godavery basin. That chain remained untouched for fifty years; it was then resumed and completed, but with the loss of the executive officer, Mr. George Shelverton, who succumbed when he had not yet reached, but was within sight of, the east coast line, the goal towards which his labours were directed. Many regions, as the basin of the Mahanaddi, the valley of Assam, the hill ranges of Tipperah, Chittagong, Arracan, and Burma, and those to the east of Moulmein and Tennasserim, which form the boundary between the British and the Siamese territories, are covered with dense forest, up to the summits of the peaks which had to be adopted as the sites of the survey stations. As a rule the peaks were far from the nearest habitation, and they could not be reached until pathways to them had been cut through forests tangled with a dense undergrowth of tropical jungle; not unfrequently large areas had to be cleared on the summits to open out the view of the surrounding country. Here the physical difficulties to be overcome were very considerable, and they were increased by the necessity that arose, in almost every instance, of importing labourers from a great distance to perform the necessary clearances. But the broad belt of forest tract known as the Terai, which is situated in the plains at the feet of the Nepalese Himalayas, was the most formidable region of all, because the climate was very deadly for a great portion of the year, and more particularly during the season when the atmosphere was most favourable for the observations, though the physical difficulties were not so great as in the hill tracts just mentioned, and labour was more easily procurable. Lying on the British frontier, at the northern extremities of no less than ten of the meridional chains of triangles, it had necessarily to be operated in to some extent, and Everest wished to carry the several chains across it, on to the outer Himalayan range, and then to connect them together by a longitudinal chain running along the range from east to west, completing the gridiron in this quarter. But the range was a portion of the Nepalese territories, and all Europeans—excepting those attached to the British embassy at Khatmandu—were debarred from entering any part of Nepal, by treaty with the British Government. Everest hoped that the rulers of Nepal might make an exception in his favour for the prosecution of a scientific survey; and when he found they would not, he urged the Government to compel them to give his surveyors access, at least, to their outlying hills; but he urged in vain, for the Government would not run the risk of embarking in a war with Nepal for purely scientific purposes. Thus the connecting chain of triangles—now known as the N.E. Longitudinal Series—had to be carried through the whole length of the Terai, a distance of about 500 miles, which involved the construction of over 100 towers—raised to a height of about 30 feet to overlook the earth's curvature—and the clearance of about 2,000 miles of line through forest and jungle to render the towers mutually visible. It required no small courage on Everest's part to plunge his surveyors into this region; he endeavoured to minimise the risks as much as possible by taking up the longitudinal chain in sections, bit by bit, on the completion of the successive meridional chains, and thus apportioning it between several survey parties, each operating in the Terai for a short time, instead of assigning it to a single party to execute continuously from end to end, all the other chains of triangles. But notwithstanding these precautions, the peril was great, and the mortality among the officers and men was very considerable; greater than in many a famous battle, says Mr. Clements Markham, in an eloquent passage in his Memoir of the Indian Surveys, in which he claims for the surveyors who were employed on these operations—with no hope of reward other than the favourable notice of their immediate chief and colleagues—merit for more peaceful and honourable achievement than much of the military service which is plentifully rewarded by the praises of men and prizes of all kinds.

Everest retired in 1843, and was succeeded by Waugh, who applied himself energetically to the completion of the several chains of triangles exterior to the Great Arc, for which he obtained a substantial addition to the existing equipment of great theodolites. It was under him that the formidable longitudinal series through the Terai, which had been begun by Everest, was chiefly carried out. He personally initiated the determination of the positions and heights of the principal peaks of the Himalayan ranges; and he did much for the advancement of the general topography of India, which had somewhat languished under his predecessor, who had devoted himself chiefly to the geodetic operations. He retired in 1861, and I succeeded to the charge of the Great Trigonometrical Survey. The last chain of the principal triangulation was completed in 1882, shortly before my own retirement.

Of the general character of the operations, it may be said without hesitation that a degree of accuracy and precision has been attained which has been reached by few and surpassed by none of the great national surveys carried out in other parts of the world, and which leaves nothing to be desired even for the requirements of geodesy; a very considerable majority of the principal angles have been measured with the great 24- and 36-inch theodolite, and their theoretical probable error averages about a quarter of a second; of the linear measurements the probable error, so far as calculable, may be taken as not exceeding the two-millionth part of any measured length. And as regards the extent of the triangulation, if we exclude the primary network in Southern India, and all secondary triangulation, however valuable for geographical purposes, we still have a number of principal chains—meridional, longitudinal, and oblique—of which the aggregate length is 17,300 miles, which contain 9,230 first-class angles observed, and rest on eleven base-lines measured with the Colby apparatus of compensation bars and microscopes. This prodigious amount of field-work furnishes an enormous mass of interdependent angular and linear measures; and each of these is fallible in some degree, for, great as was the skill and care with which they had severally been executed, absolute accuracy of measurement is as yet beyond human achievement; thus every circuit of triangles, every chain closing on a base-line, and even every single triangle, presented discrepancies, the magnitude of which was greater or less according as derived from a combination of many, or only of a few, of the fallible facts of observation. Thus, when the field operations were approaching their termination, the question arose as to how these facts were to be harmonised and rendered consistent throughout, which was a very serious matter considering their great number. The rigorous application of mathematical theory to a problem of this nature requires the adjustment to be effected by the application of a correction to every fact of observation, not arbitrarily, but in such a manner as to give it its proper weight, neither more nor less, in the final investigation, and in this the whole of the facts must be treated simultaneously. That would have involved the simultaneous solution of upwards of 4,000 equations between 9,230 unknown quantities, by what is called the method of minimum squares, and I need scarcely say that it is practically impossible to solve such a number of equations between so many unknown quantities by any method at all. Thus a compromise had to be made between the theoretically desirable and the practically possible. It would be out of place here to attempt to describe the method of treatment which was eventually adopted, after much thought and deliberation; I will simply say that the bulk of the triangulation was divided into sections, each of which was treated in succession with a close approximation to the mathematically rigorous method as far as practically possible; but even then the mass of simultaneous interdependent calculation to be performed in each instance was enormous, I believe greatly exceeding anything of the kind yet attempted in any other survey. But the happy result of all this labour was that the final corrections of the angles were for the most part very minute, less than the theoretical probable errors of the angles, and thus fairly applicable without taking any liberties with the facts of observation. If the attribute of beauty may ever be bestowed on such things as small numerical quantities, it may surely be accorded to these notable results of very laborious calculations, which, while in themselves so small, were so admirably effective in introducing harmony and precision throughout the entire triangulation.

If now we turn once more to what Lambton calls "the sublime science of geodesy," which was held in such high regard by both him and Everest, we shall find that the great meridional arc between Cape Comorin and the Himalayas, on which they laboured with so much energy and devotion, is not the only contribution to that science to which the Indian triangulation is subservient, but every chain of triangles—meridional, longitudinal, or oblique—may be made to throw light either on geodesy, the science of the figure of the earth, or on geognosy, the science of the earth's interior structure, when combined with corresponding astronomical arcs of amplitude. Thus each of the several meridional chains of triangles may be utilised in this way, as their prototype has been, by having latitude observations taken at certain of their stations to give meridional arcs; and the several longitudinal chains of triangles may also be utilised—in combination with the main lines of telegraph—by electro-telegraphic determinations of differential longitudes to give arcs of parallel. When the stations of the triangulation which are resorted to for the astronomical observations are situated in localities where the normal to the surface coincides fairly with the corresponding normal to the earth's figure, the result is valuable as a contribution to geodesy; when the normal to the surface is sensibly deflected by local attraction, the result gives a measure of the deflection which is valuable as a contribution to geognosy.

Having regard to these circumstances, I moved the Government to supply the Trigonometrical Survey with the necessary instruments for the measurement of the supplemental astronomical arcs; and as officers became available on the gradual completion of the successive chains of triangles, I employed some of them in the required determinations of latitude and differential longitude. It so happened that about the same time geodesists in Europe began to recognise the advantages to science to be acquired by connecting the triangulations of the different nationalities together, and supplementing them with arcs of amplitude. The "International Geodetic Association for the Measurement of Degrees in Europe" was formed in consequence, and it has been, and is still, actively employed in carrying out this object; in India, however, the triangulation was complete and connected throughout, so that only the astronomical amplitudes were wanting. They are still in progress, but already meridional chains, aggregating 1,840 miles in length, and lying to the west of the Great Arc, have been converted into meridional arcs; and the three longitudinal chains, from Madras to Mangalore, from Bombay to Vizagapatam, and from Kurrachee *via* Calcutta to Chittagong, of which the aggregate length is 2,600 miles, have been converted into arcs of parallel. In the former the operations follow the meridional course of the chains of triangles; in the latter they follow the principal lines of the electric telegraph, which sometimes diverge greatly from the direction of the longitudinal chains of triangles, the two only intersecting at occasional points; the astronomical stations are therefore placed at the trigonometrical points which may happen to be nearest the telegraph lines, whether on the meridional or on the longitudinal chains, and their positions are invariably so selected as to form self-verificatory circuits which are usually of a triangular form, presenting three differential arcs of longitude; each of these arcs is measured independently as regards the astronomical work—though for the third arc there is usually no independent telegraph line but only a coupling of the lines for the first and second arcs—and this has been proved to give such an excellent check on the accuracy of the operations, that it is not too much to say that no telegraphic longitude operations are entirely reliable which have not been verified in some such manner.

Through the courtesy of Colonel Stotherd, Director-General of the Ordnance Survey, I am enabled to exhibit two charts, one of the triangulation of India, the other of that of Europe, which have recently been enlarged to the same scale in the Ordnance Survey Office at Southampton for purposes of comparison. The first is taken from the official chart of the Indian Survey, and shows the great meridional and longitudinal chains and Lambton's network of principal triangles, the positions of the base-lines measured with the Colby apparatus, the latitude and the differential longitude stations, the triangular circuits of the longitudinal arcs, the stations of the pendulum and the tidal operations which will be noticed presently, and the secondary triangulations to fix the peaks of the Himalayan and Sulimani ranges, and the positions of Bangkok in Siam and Kandahar in Afghanistan, the extreme eastern and western points yet reached. The chart of the European triangulation has been enlarged from one published by the International Geodetic Association of Europe; in it special prominence is given to the Russian meridional arc, which extends from the Danube to the Arctic Ocean, and is 25° 20′ in length, and to the combined English and French meridional arc, 22° 10′ in length, which extends from the Balearic Island of Formentera in the Mediterranean, to Saxavord in the Shetland Islands. The aggregate length of the meridional arcs already completed in India is about equal to that of the English, French, and Russian arcs combined; but the longest in India is about $1\frac{1}{2}$° shorter than the Russian. As regards longitudinal arcs, I believe the two which were first measured in India, and were employed shortly afterwards by Colonel Clarke in his last investigation of the figure of the Earth, are the only ones which have as yet been deemed sufficiently accurate to be made use of in such investigations, though arcs of much greater length have been measured in Europe. It would be interesting, if time permitted, to set forth the salient points of divergence between the systems of the Indian and the European surveys; I will only mention that in the southern part of the Russian arc, for a space of about 8° from the Duna to the Dneister, a vast plain, covered with immense and almost impenetrable forests, presented great obstacles to the prosecution of the work; the difficulty was overcome by the erection of a large number of lofty stations of observation, wooden scaffoldings which were 120 and even as much as 146 feet high, to overlook the forests. In Indian forests, as the Terai on the borders between British and Nepalese territories, the stations were rarely raised to a greater height than 30 feet, or just sufficient to overtop the curvature, and all trees and other obstacles were cleared away on the lines between them; this was found the most expeditious and economical process. The stations were very substantial, with a central masonry pillar, for the support of a great theodolite, which was isolated from the surrounding platform for the support of the observer. The lofty Russian scaffoldings only sufficed for small theodolites, and they were so liable to shake and vibration, that the theodolites had to be fitted with two telescopes to be pointed simultaneously by two observers at the pair of stations, the angle between which was being measured.

All the modern geodetic data of the Indian survey that were available up to the year 1880 were utilised by Colonel A. R. Clarke, C.B., of the Ordnance Survey, in the last of the very valuable investigations of the Figure of the Earth which he has undertaken from time to time. It will be obvious that new data tend to modify in some degree the conclusions derived from previous data, for the figure of so large a globe as our earth is not to be exactly determined from measurements carried over a few narrow belts of its superficies. Thus thirty years ago it was inferred that the equator was sensibly elliptic—and not circular, as had been generally assumed—with its major axis in longitude 15° 34′ east of Greenwich; but later investigations indicate a far smaller ellipticity, and place the major axis in west longitude 8° 15′. More significant evidence of the influence of new facts of observation in modifying previous conclusions is furnished by the French national standard of length, the metre, which was fixed at the ten-millionth part of the length of the earth's meridional quadrant, as deduced from the best geodetic data available up to the end of the last century; but it is now found to be nearly $\frac{1}{5000}$th part less than the magnitude which it is supposed to represent, the difference being about a hundred times greater than what would now be considered an allowable error in an important national standard of measure.

The Indian survey has also made valuable contributions to geodesy and geognosy in an elaborate series of pendulum observations for determining variations of gravity, which throws light both on the grand variation from the poles to the equator that governs the ellipticity, and on the local and irregular variations depending on the constitution of the interior of the earth's crust. They were commenced in 1865 by Captain J. P. Basevi, on the recommendation of General Sabine and the Council of the Royal Society, with two pendulums, one of which the General had swung in his notable operations which extend from a little below the equator to within 10° of the pole. Captain Basevi had nearly completed the operations in India, and had taken swings at a number of the stations of the Great Arc and at various other points near mountain ranges and coast lines, when he died of exposure in 1871 at a station on the high table-lands of the Himalayas, while investigating the force of gravity under mountain ranges. Major Heaviside swung the pendulums at the remaining Indian stations, then at Aden and Ismailia on the way back to England, and finally at the base station, the Kew Observatory. Afterwards they and a third pendulum were swung at Kew and Greenwich by Lieutenant-Colonel Herschel, who took all three to America, swung them at Washington, and then handed them over to officers of the United States Coast Survey, by whom they have been swung at San Francisco, Auckland, Sydney, Singapore, and in Japan.

The pendulum operations in India have been successful in removing from the geodetic operations the reproach which had latterly been cast on them, that their value has become much diminished since the discovery that the attraction of the Himalayan mountains is so much greater than had previously been suspected, that it may have materially deflected the plumb-line at a large number of the astronomical stations of the Great Arc, and injuriously influenced the observations. Everest considered the effects of the Himalayan attraction to be immaterial at any distance exceeding sixty miles from the feet of the mountains; but in his days the full extent and elevation of the mountain masses was unknown, and their magnitude was greatly underestimated. Afterwards, when the magnitude became better known, Archdeacon Pratt of Calcutta, a mathematician of great eminence, calculated that they would materially attract the plumb-line at points many hundred miles distant; he also found that everywhere between the Himalayas and the ocean, the excess of density of the land of the continent as compared with the water of the ocean would combine with the Himalayan attraction and increase the deflection of the plumb-line northwards, towards the great mountain ranges, and that under the joint influence of the Himalayas and the ocean the level of the sea at Kurrachee would be raised 560 feet above the level at Cape Comorin.

But as a matter of fact the Indian arc gave a value of the earth's ellipticity which agreed sufficiently closely with the values derived from the arcs measured in all other quarters of the globe, to show that it could not have been largely distorted by deflections of the plumb-line; thus it appeared that whereas Everest might have slightly underestimated the Himalayan attraction, Pratt must have greatly overestimated it. His calculations were however based on reliable data, and were indubitably correct. For some time the contradiction remained unexplained, but eventually Sir George Airy put forward the hypothesis that the influence of the Himalayan masses must be counteracted by some compensatory disposition of the matter of the earth's crust immediately below them, and in which they are rooted; he suggested that the bases of the mountains had sunk to some depth into a fluid lava which he conceived to exist below the earth's crust, and that the sinking had caused a displacement of dense matter by lighter matter below, which would tend to compensate for the excess of matter above. Now Pratt's calculations had reference only to the visible mountain and oceanic masses, and their attractive influences—the former positive, the latter negative—in a horizontal direction; he had no data for investigating the density of the crust of the earth below either the mountains on the one hand, or the bed of the ocean on the other. The pendulum observations furnished the first direct measures of the vertical force of gravity in different localities which were obtained, and these measures revealed two broad facts regarding the disposition of the invisible matter below; first, that the force of gravity diminishes as the mountains are approached, and is very much less on the summit of the highly elevated Himalayan table-lands than can be accounted for otherwise than by a deficiency of matter below; secondly, that it increases as the ocean is approached, and is greater on islands than can be accounted for otherwise than by an excess of matter below. Assuming gravity to be normal on the coast lines, the mean observed increase at the island stations was such as to cause a seconds' pendulum to gain three seconds daily, and the mean observed decrease in the interior of the Continent would have caused the pendulum to lose 2½ seconds daily at stations averaging 1,200 feet above the sea level, 5 seconds at 3,800 feet, and about 22 seconds at 15,400 feet—the highest elevation reached—in excess of the normal loss of rate due to height above the [illegible]

Pratt was strongly opposed to the hypothesis of a sub[illegible] or magma, of fluid igneous rock beneath the mountain[illegible] assumed the earth to be solid throughout, and regarde[illegible] mountains as an expansion of the invisible matter below, [illegible] thus becomes attenuated and lighter than it is under reg[illegible] less elevation, and more particularly in the depressions and [illegible] tractions below the bed of the ocean. And certainly we [illegible] to have more reason to conclude that the mountains em[illegible] from the subjacent matter of the earth's crust than that the[illegible] as wholly independent of it as if they were formed of stu[illegible] from passing meteors and asteroids; any severance of con[illegible] and association between the visible above and the invisible [illegible] appears, on the face of it, to be decidedly improbable.

The hypothesis of sub-continental attenuation and sub-o[illegible] condensation of matter is supported by the two arcs of lo[illegible] on the parallels of Madras and Bombay; for at the ex[illegible] points of these arcs, which are situated on the opposite coas[illegible] the horizontal attraction has been found to be not landwar[illegible] might have been anticipated, but seawards, showing that the [illegible] ficient density of the sea as compared with the land is more [illegible] compensated by the greater density of the matter under [illegible] ocean than of that under the land.

While on the subject of the constitution of the earth's c[illegible] I may draw attention to the circumstance that the tidal ob[illegible] ations which have been carried on at a number of points on [illegible] coasts of India, as a part of the operations of the Survey, [illegible] to show that the earth is solid to its core, and that the geol[illegible] hypothesis of a fluid interior is untenable. They have be[illegible] analysed by Prof. G. H. Darwin, with a view to the determin[illegible] ation of a numerical estimate of the rigidity of the earth, and [illegible] has ascertained that whilst there is some evidence of a [illegible] yielding of the earth's mass, that yielding is certainly small, and the effective rigidity is very considerable, not so great as that [illegible] steel, as was at first surmised, but sufficient to afford an imp[illegible] confirmation of the justice of Sir William Thomson's conclu[illegible] as to the great rigidity.

The Indian pendulum observations have been employe[illegible] Colonel Clarke, in combination with those taken in other p[illegible] of the globe, to determine the earth's ellipticity. Formerly [illegible] was wont to be a material difference between the ellipt[illegible] which were respectively derived from pendulum observation[illegible] direct geodetic measurements, the former being somewhat grea[illegible] than $\frac{1}{288}$, the latter somewhat less than $\frac{1}{29[illegible]}$; but as new [illegible] more exact data became available, the values derived from the[illegible] two essentially independent sources became more and mo[illegible] accordant, and they now nearly agree in the value $\frac{1}{29[illegible]}$.

As a part of the pendulum operations, a determination of t[illegible] length of the seconds' pendulum was made at Kew by M[illegible] Heaviside, with the pendulum which had been employed for [illegible] same purpose by Kater early in the present century, when lea[illegible] men of science in England believed that in the event of the national standard yard being destroyed or lost, the length mig[illegible] be reproduced at any time with the aid of a reversible pendulum. In consequence of this belief an Act of Parliament was passed in 1824 which defined the relations between the imperial and the seconds' pendulum, the length of the former being to that of the latter—swung in the latitude of London, in a vacuum and at the level of the sea—in the proportion of 36 inches to 39·1393 inches. Thus, while the French took for their unit of length the ten millionth part of the earth's meridional quadrant, the English took the pendulum swinging seconds in the latitude of London. In case of loss the yard is obviously recoverable more readily and inexpensively by reference to the pendulum than the metre by reference to the quadrant; it is also recoverable with greater accuracy; still the accuracy is not nearly what would now be deemed indispensable for the determination of a national standard of length, and it is now generally admitted that every pendulum has certain latent defects, the influence of which cannot be exactly ascertained. Thus the instrument cannot be relied on as a suitable one for [illegible] of absolute length; but on the other h[illegible] its condition remains unaltered, it is th[illegible] yet [illegible] the differential [illegible] of gravity [illegible] [illegible], however, [illegible] employ even [illegible] and with [illegible] of [illegible] determination [illegible] as a great [illegible] which satisfactory results can [illegible] of many days, the boon to scie[illegible]

The trigonometrical operations fix with extreme accuracy two of the co-ordinates—the latitude and longitude—which define the positions of the principal stations; but the third co-ordinate, the height, is not susceptible of being determined by such operations with anything like the same degree of accuracy, because of the variations of refraction to which rays of light passing through the lower strata of the atmosphere are liable, as the temperature of the surface of the ground changes in the course of the day. In the plains the apparent height of a station ten to twelve miles from the observer has been found to be upwards of 100 feet greater in the cool of the night than in the heat of the day, the refraction being always positive when the lower atmospheric strata are chilled and laden with dew, and negative when they are rarefied by the heat radiated from the surface of the ground. At hill stations the rays of light usually pass high above the surface of the ground, and the diurnal variations of refraction are comparatively immaterial, and very good results are obtained by the expedient of taking the vertical observations between reciprocating stations at the same hour of the day, and as nearly as possible at the time of minimum refraction; but in the plains this expedient does not usually suffice to give reliable results. The hill ranges of central and those of northern India are separated by a broad belt of plains, which embraces the greater portion of Sind, the Punjab, Rajputana, and the valley of the Ganges, and is crossed by a very large number of the principal chains of triangles, on the lines where the chart shows stretches of comparatively small triangles, which are in most instances of considerable length. Thus it became necessary to run lines of spirit levels over these plains, from sea to sea, to check the trigonometrical heights. The opportunity was taken advantage of to connect all the levels which had been executed for irrigation and other public works, and reduce them to a common datum; and eventually lines of level were carried along the coast and from sea to sea to connect the tidal stations. The aggregate length of the standard lines of level executed up to the present time is nearly 10,000 miles, and an extensive series of charts of the levels derived from other departments of the public service and reduced to the survey datum has already been published.

The survey datum which has been adopted for all heights, whether deduced trigonometrically or by spirit-levelling, is the mean sea level as determined, either for initiation or verification, by tidal observations at several points on the coast lines. At first the observations were restricted to what was necessary for the requirements of the survey, and their duration was limited to a lunar month at each station. In 1872 more exact determinations were called for, to ascertain whether gradual changes in the relative level of land and sea were taking place at the head of the Gulf of Cutch, as had been surmised by the geological surveyors, and observations were taken for over a year at three tidal stations on the coasts of the gulf, to be repeated hereafter when a sufficient period had elapsed to permit of a measurable change of level having taken place. Finally, in 1875, the Government intimated that as "the great scientific advantages of a systematic record of tidal observations on Indian coasts had been frequently urged and admitted," such observations should be taken at all the principal ports and at such points on the coast lines as were best suited for investigations of the laws of the tides. In accordance with these instructions, five years' observations have been made at several points, and new stations are taken up as the operations at the first ones are completed.

The initiation of the later and more elaborate operations is due in great measure to the recommendations of the Tidal Committee of the British Association, of which Sir William Thomson was President. The tidal observations have been treated by the method of harmonic analysis advocated by the Committee. The constants for amplitude and epoch are determined for every tidal component, both of long and of short periods, and with their aid tide-tables are now prepared and published annually for each of the principal ports; and further, it is with them that Prof. G. H. Darwin made the investigations of the effective rigidity [illegible] earth, which I have already mentioned. The very [illegible] which were caused by the earthquake on De[illegible] the Bay of Bengal, and by the notable vol[illegible] Island of Krakatoa and the Straits of Sun[illegible] 883, were registered at several of the [illegible] evidence has been furnished of the [illegible] and the ocean-wave [illegible] of the ordinarily

I must not close this account of the non-graphical, or more purely scientific, operations of the great Trigonometrical Survey of India without saying something of the officers who were employed thereon, under the successive superintendence of Everest, Waugh, and myself. A considerable majority were military, from all branches of the army—the cavalry and infantry, as well as the corps of engineers and artillery; the remainder were civilians, mostly promoted from the subordinate grades. Prominent shares in the operations were taken by Lieutenant Renny, Bengal Engineers, afterwards well known in this neighbourhood as Colonel Renny Tailyour, of Borrowfield in Forfarshire, of whom and his contemporary, Lieutenant Waugh, Everest, retiring, reported in terms of the highest commendation; by Reginald Walker, of the Bengal Engineers, George Logan, George Shelverton, and Henry Beverley, all of whom fell victims to jungle fever; by Strange, F.R.S., of the Madras Cavalry, whose name is associated with the construction of the modern geodetic instruments of the Survey; by Jacob—afterwards Government Astronomer at Madras—Rivers and Haig, all of the Bombay Engineers; Tennant, C.I.E., F.R.S., Bengal Engineers, afterwards Master of the Mint in Calcutta; Montgomerie, F.R.S., of the Bengal Engineers, whose name is best remembered in connection with the Trans-Himalayan geographical operations; James Basevi, of the Bengal Engineers, who so sadly died of exposure while engaged on the pendulum operations in the higher Himalayas; Branfill, of the Bengal Cavalry; Thuillier, Carter, Campbell, Trotter, Heaviside, Rogers, Hill, and Baird, F.R.S., all engineer officers; also Hennessey, C.I.E., F.R.S., M.A., Herschel, F.R.S., and Cole, M.A., whose names are intimately associated with the collateral mathematical investigations and the final reduction of the principal triangulation.

The Trigonometrical Survey owes very much to the liberal and even generous support which it has invariably received from the Supreme Government, with the sanction and approval, first of the Directors of the East India Company, and afterwards of the Secretary of State for India. In times of war and financial embarrassment the scope of the operations has been curtailed, the establishments have been reduced, and some of the military officers sent to join the armies in the field; but whatever the crisis, the operations have never been wholly suspended. Even during the troubles of 1857-58, following the mutiny of the native army, they were carried on in some parts of the country, though arrested in others; and the then Viceroy, Lord Canning, on receiving the reports of the progress of the operations during that eventful period, immediately acknowledged them to the Surveyor-General, Colonel Waugh, in a letter from which the following extract is taken:

"I cannot resist telling you at once with how much satisfaction I have seen these papers. It is a pleasure to turn from the troubles and anxieties with which India is still beset, and to find that a gigantic work, of permanent peaceful usefulness, and one which will assuredly take the highest rank as a work of scientific labour and skill, has been steadily and rapidly progressing through all the turmoil of the last two years."

The operations have been uninfluenced by changes of *personnel* in the administration of the Indian Empire, as Governor-Generals and Viceroys succeeded each other, but have met with uniform and consistent support and encouragement. It may well be doubted whether any similar undertaking, in any other part of the world, has been equally favoured and as munificently maintained.

In conclusion I must state that I have purposely said nothing of the graphical operations executed in the Trigonometrical and other branches of the Survey of India, because they are more generally known, their results appear in maps which speak for themselves, and time would not permit of my attempting to describe them also. They comprise, *first*, the general topography of all India, mostly on the standard scale of 1 inch to the mile; *secondly*, geographical surveys and explorations of regions beyond the British frontier, notably such as are being carried on at the present time on the Russo-Afghan frontier, by Major Holdich and other officers of the Survey; *thirdly*, the so-called Revenue Survey of the British districts in the Bengal Presidency, which is simply a topographical survey on an enlarged scale—4 inches to the mile—showing the boundaries and areas of villages for fiscal requirements; and *fourthly*, the Cadastral Survey of certain of the British districts in the Bengal Presidency, showing fields and the boundaries of all properties, on scales of 16 to 32 inches to the mile. There are also certain large scale surveys of portions of British districts in the Madras and Bombay Presidencies, which, though undertaken originally for purely fiscal purposes by revenue and settlement officers working independently of the professional survey, have latterly been required to contribute their quota to the general topography of the country. And of late years a survey branch has been added to the Forest Department, to provide it with working maps constructed for its own requirements on a larger scale than the standard topographical scale, but on a trigonometrical basis, and in co-operation with the Survey Department. But this brief capitulation gives no sort of idea of the vast amount of valuable topographical and other work for the requirements of the local Administrations and the public at large—always toilsome, often perilous—which has been accomplished, quite apart from and in quantity far exceeding the non-graphical and more purely scientific work which I have been describing. Its magnitude and variety are such that a mere list of the officers who have taken prominent shares in it, from first to last, would be too long to read to you. Three names, however, I must mention: *first*, that of General Sir Henry Thuillier, who became Surveyor-General on the same day that I succeeded to the superintendence of the Great Trigonometrical Survey, and with whom I had the honour of co-operating for many years; under his administration a much larger amount of topography was executed than under any of his predecessors, and a great impetus was given to the lithographic, photographic, engraving and other offices in which the maps of the survey are published; *secondly*, that of Colonel Sconce, who became Deputy Surveyor-General soon after my accession in 1878 to the Survey-Generalship, and with whom I was associated for some years, much to my gratification and advantage, in various matters, but more particularly in the establishment of cadastral surveys on a professional basis at a moderate cost, to render them more generally feasible, which was a matter of the utmost importance for the administration of the more highly populated portions of the British provinces; and *thirdly*, that of Lieutenant-Colonel Waterhouse, who has for many years superintended the offices in which photography is employed, in combination with zincography and lithography, for the speedy reproduction *en masse* of the maps of the Survey, and has done much to develop the art of photogravure, whereby drawings in brushwork and mezzotint may be reproduced with a degree of excellence rivalling the best copperplate engraving, and almost as speedily and cheaply as drawings in pen and ink work are reproduced by photo-zincography.

Mr. Clements Markham's Memoir on the Indian Surveys gives the best account yet published of the several graphical surveys up to the year 1878. In that year the Trigonometrical, Topographical, and the Revenue branches, which up to that time had constituted three separate and almost independent departments, were amalgamated together into what is now officially designated "the Survey of India." In the same year the chronicle so well commenced by Mr. Markham came to an end on his retirement from the India office—unfortunately, for it is a work of excellence in object and in execution, and most encouraging to Indian surveyors, who find their labours recorded in it with intelligent appreciation and kindly recognition.

During the present meeting, several papers by officers of the Survey will be read—one by Colonel Barron, in person, on the cadastral surveys in the organisation of which he has taken a leading share; by Major Baird, on the work of spirit-levelling, which he superintends conjointly with the tidal observations; by Colonel Godwin Austen, on Lieutenant-Colonel Woodthorpe's recent journey from Upper Assam to the Irawadi river; by Colonel Branfill, on the physical geography of Southern India; and by Colonel Tanner, on portions of the Himalayas, and on recent explorations in Southern Tibet. Major Bailey will also read a paper on the forest surveys.

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## SECTION G

### MECHANICAL SCIENCE

OPENING ADDRESS BY B. BAKER, M.INST.C.E., PRESIDENT OF THE SECTION

Two hundred and fifty-seven Presidential Addresses of one kind and another have been delivered at meetings of the British Association since the members last mustered at Aberdeen. I need hardly say that the candid friend who informed me of this interesting fact most effectually dispelled any illusion I may have previously entertained as to the possibility of preparing an address of sufficient novelty and suggestiveness to be worthy of your attention, and I can only hope that any shortcomings will be dealt with leniently by you. One compensating advantage obviously belongs to my late appearance in the field—I have 257 models of style upon which to frame my address. My distinguished predecessor, Sir Frederick Bramwell, has a style of his own, in which wit and wisdom are combined in pleasing proportions; but were I to attempt this style I should doubtless incur the rebuke which a dramatic critic of Charles the Second's time administered to a too ambitious imitator of a popular favourite: "He's got his fiddle, but not his hands to play it." I must search further back than last year, therefore, for a model of style, and the search reminds me that I labour under a double disadvantage: firstly, that only two addresses intervene between the present one and that of my partner, Mr. John Fowler, with whom I have so long had the honour of being associated, and whose professional experiences, as set forth in his address, are necessarily so largely identical with my own; and, secondly, that within the same period I have read before this Section two somewhat lengthy papers on the work which is at present so engaging the attention of Mr. Fowler and myself—the great Forth Bridge.

Although, for the reasons aforesaid, I am conscious that my address may fail in novelty, I cannot honestly profess to feel difficulty in preparing an address of some kind, for the subjects embraced under the head of "Mechanical Science" are so inexhaustible that even the youngest student might safely accept the responsibility of speaking for an hour on some of them. Prof. Rankine, addressing you thirty years ago, said it was to be understood that questions of pure or abstract mechanics formed part of the subjects dealt with in this Section. With characteristic clearness of conception and precision of language he told you what the term "mechanical science" meant, and, after thirty years' interval, his words may be recalled with advantage to every one proposing to prepare an address or report for this Section. "Mechanical science," said Prof. Rankine, "enables its possessor to plan a structure or machine for a given purpose without the necessity of copying some existent example; to compute the theoretical limit of the strength and stability of a structure or the efficiency of a machine of a particular kind; to ascertain how far an actual structure or machine fails to attain that limit, and to discover the cause and the remedy of such shortcoming; to determine to what extent, in laying down principles for practical use, it is advantageous for the sake of simplicity to deviate from the exactness required by pure science; and to judge how far an existing practical rule is founded on reason, how far on custom, and how far on error." There is thus an ample text for many discourses; but, as I am not writing a treatise on engineering, but merely delivering a sectional address, I will confine my attention at present to a particular case of the branch of mechanical science referred to in the last clause of Prof. Rankine's definition, and will ask you to consider how far the existing practical rules respecting the strength of metallic bridges are "founded on reason, how far on custom, and how far on error."

The first question obviously is, What are the rules adopted by engineers and Government departments at the present time?—and it is one not easily answered. I have for some time past been receiving communications from leading Continental and American engineers, asking me what is my practice as regards the admissible intensity of stress on iron and steel bridges, and in replying I have invited similar communications from themselves. As a result I am able to say that at the present time absolute chaos prevails. The old foundations are shaken, and engineers have not come to any agreement respecting the rebuilding of the structure. The variance in the strength of existing bridges is such as to be apparent to the educated eye without any calculation. If the wheels of a miniature brougham were fitted to a heavy cart the incident would excite the derision even of the street boys, and yet equal want of reason and method is to be found in hundreds of bridges in all countries. It is an open secret that nearly all the large railway companies are strengthening their bridges, and necessarily so, for I could cite cases where the working stress on the iron has exceeded by 250 per cent. that considered admissible by leading American and German bridge-builders in similar structures.

In the case of old bridges the variance in strength is due partly due to errors in hypothesis and miscalculation of stresses. In the present day engineers of all countries are in accord as the principles of estimating the magnitude of the stresses on the different members of a structure, but not so in proportioning the members to resist those stresses. The practical result is that a bridge which would be passed by the English Board of Trade would require to be strengthened 5 per cent. in some parts and 60 per cent. in others before it would be accepted by the German Government or by any of the leading railway companies in America. This undesirable state of affairs arises from the fact that in our own and some other countries many engineers still persistently ignore the fact that a bar of iron may be broken in two ways—namely, by the single application of a heavy stress or by the repeated application of a comparatively light stress. An athlete's muscles have often been likened to a bar of iron, but, if "fatigue" be in question, the simile is very wide of the truth. Intermittent action—the alternative pull and thrust of the rower, or of the labourer turning a winch—is what the muscle likes and the bar of iron abhors. Troopers dismount to rest their horses, but to relieve a bar of iron temporarily of load only serves to fatigue it. Half a century ago Braithwaite correctly attributed the failure of some girders, carrying a large brewery vat, to the vessel being sometimes full and sometimes empty, the repeated deflection, although imperceptibly slow and wholly free from vibration, deteriorating the metal, until, in the course of years, the girders broke. These girders were of cast-iron; but it was equally well known that wrought-iron was similarly affected, for in 1842 Nasmyth called the attention of this Section to the fact that the "alternate strain" in axles rendered them weak and brittle, and suggested annealing as a remedy, he having found that an axle which would snap with one blow when worn would bear eighteen blows when new or after being annealed.

So important a matter as the action of intermittent stresses could not escape the attention of the Royal Commissioners appointed in 1849 to consider the application of iron to railway structures, and some significant and sufficiently conclusive experiments were made by Capt. Douglas Dalton and others. Cast-iron bars 3 inches square and 13 feet 6 inches span between the supports were deflected, both by the slow action of a cam and the percussive action of a swinging pendulum weight. When the deflection was that due to one-third of the breaking weight, about 50,000 successive bendings by the cam broke one of the bars, and about 1000 blows from the pendulum another. When the deflection was increased from one-third to one-half, about 500 applications of the cam, and 100 blows, sufficed to rupture two of the specimens. Slow-moving weights on bars and on a small wrought-iron box girder gave analogous results; and the deduction drawn by the experimenters at the time was that "iron bars scarcely bear the reiterated application of one-third the breaking weight without injury, hence the prudence of always making beams capable of bearing six times the greatest weight that could be laid upon them."

Although these experiments were entirely confirmatory of all previous experience, they would appear to have little influenced the practice of engineers, since Fairbairn, more than ten years later, in a communication to this Section, said that opinions were still much divided upon the question whether the continuous change of load which many wrought-iron structures undergo has any permanent effect upon their ultimate powers of resistance. To assist in settling the question he communicated to the Association the results of some experiments carried out by himself and Prof. Unwin on a little riveted girder 20 feet span and 16 inches deep. Once more the same important but disregarded facts were enforced on the attention of engineers. About 5000 applications of a load equal to four-tenths of the calculated breaking load fractured the beam with the small ultimate deflection of three-eighths of an inch, and subsequently, when repaired, the beam broke with one-third of the load and a deflection of but a quarter of an inch, which sufficiently indicated how small a margin the factor of safety of four, when currently adopted, allowed for defective manufacture, inferior material, and errors in calculation. Still nothing was done, and the general practice of engineers and the Board of Trade regulations continued unaltered.

Soon after the introduction of wrought-iron bridges on railways, the testimony of practical working was added to that of experiments. In 1848 several girder bridges of unduly light proportions were erected in America, and one of 66 feet span broke down under the action of the rolling load in the same manner as Fairbairn's little experimental girder. Again, in early American timber bridges the vertical tie-rods were often subject to stresses oscillating between 1 ton and 10 tons per square inch and upwards. Many of these broke, as did also the suspension bolts in platforms subjected to similar stresses. In my own experience, dozens of broken flange-plates and angle-bars, and hundreds of sheared rivets, have been the silent witnesses of the destructive action of a live load. Like evidence was afforded by early constructed iron ships deficient in girder strength. Under the alternating stresses due to the action of the waves weaknesses not at first apparent would, in the course of time be developed, and additional strength, in the way of stringers and otherwise, become imperative.

If none of the preceding evidence had been forthcoming, the results of the historical series of experiments carried out by Wöhler for the Prussian Ministry of Commerce would alone be conclusive. For the first time a truly scientific method of investigation was followed, and an attempt was made to determine the laws governing the already proved destructive action of intermittent stresses. In previous experiments the bar or girder was alternately fully loaded and wholly relieved of load. Wöhler was not satisfied with this, but tested also the result of a partial relief of load. The striking fact was soon evidenced on testing specimens under varying tensions, that the amount of the variation was as necessary to be considered as that of the maximum stress. Thus, an iron bar having a tensile strength of 24 tons per square inch broke with about 100,000 applications of a stress varying from *nil* to 21 tons, but resisted 4,000,000 applications of the 21 tons when the minimum stress was varied from *nil* to $11\frac{1}{2}$ tons. The alternations of stress in the case of some test pieces numbered no less than 132,000,000; and too much credit cannot be bestowed by engineers upon Wöhler for the ingenuity and patience which characterised his researches. As a result, it is proved beyond all further question that any bar or beam of cast iron, wrought iron, or steel may be fractured by the continued repetition of comparatively small stresses, and that, as the differences of stress increase, the maximum stress capable of being sustained diminishes.

Various formulæ based upon the preceding experiments have been proposed for the determination of the proper sectional area of the members of metallic structures. These formulæ differ in some essential respects, and doubtless many experiments are still required before any universally accepted rules can be laid down. Probably at the present time the engineers who have given the most attention to the subject are fairly in accord in holding that the admissible stress per square inch in a wrought-iron girder subject to a steady dead load would be one and a half times as great as that in a girder subject to a wholly live load, and three times that allowable in members subject to alternate tensile and compressive stresses of equal intensity, such as the piston-rod of a steam-engine or the central web-bracing of a lattice girder. If the alternations of stress to be guarded against are not assumably infinite in number, but only occasional—as in wind bracing for hurricane pressures, or in a vessel amongst exceptionally high waves—then the aforesaid ratio of 3, 2, and 1 would not apply, but would more nearly approach the ratios 6, 5, and 4.

Hundreds of existing railway bridges which carry twenty trains a day with perfect safety would break down quickly under twenty trains per hour. This fact was forced on my attention nearly twenty years ago by the fracture of a number of iron girders of ordinary strength under a five-minute train service. Similarly, when in New York last year I noticed, in the case of some hundreds of girders on the "Elevated Railway," that the alternate thrust and pull on the central diagonals from trains passing every two or three minutes had developed weaknesses which necessitated the bars being replaced by stronger ones after a very short service. Somewhat the same thing had to be done recently in this country with a bridge over the Trent, but the train service being small the life of the bars was measured by years instead of months. If ships were always amongst great waves the number going to the bottom would be largely increased, for, according to Mr. John, late of Lloyd's, "many large merchant steamers afloat are so deficient in longitudinal strength that they are liable under certain conditions of sea to be strained in the upper works to a tension of from 8 to 9 tons per square inch, and to a compression of from 6 to 7 tons—stresses which the experiments already referred to proved would cause failure after a definite number of repetitions. Similarly, on taking ground or being dry-docked with a heavy cargo on board, it has been shown that vessels are liable to stresses of over 11 tons per square inch on the reverse frames, but no permanent injury results from such high stresses, because the number of repetitions is necessarily very limited.

It appears natural enough to every one that a piece even of the toughest wire should be quickly broken if bent backward and forward to a sharp angle; but, perhaps, only to locomotive and marine engineers does it appear equally natural that the same result would follow in time if the bending were so small as to be quite imperceptible to the eye. A locomotive crank axle bends but 1-34th of an inch, and a straight driving axle the still smaller amount of 1-64th of an inch under the heaviest bending stresses to which they are subject, and yet their life is limited. During the year 1883 one iron axle in fifty broke in running, and one in fifteen was renewed in consequence of defects. Taking iron and steel axles together, the number then in use on the railways of the United Kingdom was 14,848, and of these, 911 required renewal during the year. Similarly, during the past three years no less than 228 ocean steamers were disabled by broken shafts, the average safe life of which is said to be about three or four years. In other words, experience has proved that a very moderate stress alternating from tension to compression, if repeated about one hundred million times, will cause fracture as surely as a sharp bending to an angle repeated perhaps only ten times.

I have myself made many experiments with a view to elucidate the laws affecting the strength of iron- and steel-work subject to frequent alternations of stress. Perhaps the most suggestive series was one in which I subjected flat steel bars about 3 feet long, in pairs, to repeated bendings until one bar broke, and then testing the surviving bar under direct tensile and compressive stresses to ascertain to what extent the metal had deteriorated. It had come under my notice, as a practical engineer, that if the compression members of a structure were unduly weak the fact became quickly evident, perhaps under the test load; but if, on the other hand, the tension members were weak, no evidence might appear of the fact until frequent repetition of stresses during several years had caused them to fracture without any measurable elongation of the metal. In the case of crank-shafts, also, the fracture is invariably due to a tearing and not a crushing action. It appeared to me, therefore, eminently probable that repetition of stresses might be far more prejudicial to tension than to compression members, and, if so, the fact ought to be taken account of in proportioning a structure.

This proved to be the case in my experiments. For example, the companion bars to those which had broken with 18,000 reversals of a stress less than half the original breaking weight behaved, when tested as columns thirty diameters in length, precisely the same as similar bars which had done no work at all, whereas when tested in tension the elongation was reduced from the original 25 per cent. to 2·5 per cent., and the fracture appeared to indicate that the bars had been made of three different kinds of steel imperfectly welded together. With a stress reduced by one-fourth the number of bendings required to break the bars was increased to 1,200,000. In this instance the calculated maximum working stress on the extreme fibres was 43 per cent. of the direct ultimate tensile resistance of the steel, and about 30 per cent. of the stress the bar was capable of sustaining as a beam under the single application of a load. Of course, the bars failed by tension, and the extreme fibres had thus deteriorated as regards tensile stresses to the extent indicated by the above percentages. Tested as a column, however, the injury the bar had received from the 1,200,000 bendings was inappreciable. The ductility was of course very largely reduced, but ductility is a quality of comparatively little importance when a material is in compression. There is no ductility in the slender Gothic stone columns of our cathedrals, which, though heavily stressed, have carried their loads for centuries. As I found repeated bendings raised the limit of elasticity, I rather anticipated finding an increased resistance from this cause in long columns. This did not prove to be the case, nor did I find any difference in short columns four diameters in length.

In addition to the preceding experiments with rectangular bars, I have tested the endurance of many revolving [illegible] cast iron, wrought iron, and steel, with similar resul[illegible] 5000 reversals of a stress equal to one-half the stati[illegible] weight sufficed generally to cause the snapping of a [illegible] of the above materials. When the stress was redu[illegible] number of applications increased, I found the relative [illegible] of solid beams to be more nearly proportional to the [illegible] strength of the metal than to the breaking weight of the [illegible]

a distinction of great importance where axles, springs, and similar things are concerned. Many of my experiments were singularly suggestive. Thus, it was instructive to see a bar of cast iron loaded with a weight which, according to Fairbairn's experiments, it should have carried for a long series of years broken in two minutes when set gently rotating. Also to find a bar of the finest mild steel so changed in constitution by some months of rotation as to offer no advantages either in strength or toughness over a new cast-iron bar of the same section.

Although, as already stated, many more experiments are required before universally acceptable rules can be laid down, I have thoroughly convinced myself that, where stresses of varying intensity occur, tension and compression members should be treated on an entirely different basis. If, in the case of a tension member, the sectional area be increased 50 per cent. because the stress, instead of being constant, ranges from *nil* to the maximum, then I think 20 per cent. increase would be a liberal allowance in the case of a compression member. I have also satisfied myself that if a metallic railway bridge is to be built at a minimum first cost, and be free from all future charges for structural maintenance, it is essential to vary the working stress upon the metal within very wide limits, regard being had not merely to the effect of intermittent stresses, but also to the relative limits of elasticity in tension and compression members even under a steady load.

Why an originally strong and ductile metal should become weak and brittle under the frequent repetition of a moderate stress has not yet been explained. Lord Bacon touched upon the subject two or three centuries ago, but you may consider his explanation not wholly satisfactory. He said, "Of bodies, some are fragile, and some are tough and not fragile. Of fragility, the cause is an impotency to be extended, and the cause of this inaptness is the small quantity of spirits." I am sorry to have no better explanation to offer, but whatever may be the immediate cause of fragility, no doubt exists that it is induced in metals by frequent bendings, such as a railway bridge undergoes. This fact, however, is not recognised in our Board of Trade Regulations, which remain as they were in the dark ages, as do those of the Ministry of Public Works of France and other countries. With us it is simply provided that the stress on an iron bridge must not exceed 5 tons per square inch on the effective section of the metal. In France it is still worse, as the limiting stress of rather under 4 tons per square inch is estimated upon the gross section, regardless of the extent to which the plates may be perforated by rivet holes. In neither case is any regard had in the rules to intermittent stresses or the flexure of compression members. In Austria the regulations make a small provision for these elements; and American specifications make a large one, the limiting stresses, instead of being constant at 5 tons, as with us ranging from about 2½ tons to 6½ tons per square inch, according to circumstances. It is hardly necessary that I should say more to justify my statement that, as regards the admissible intensity of stress on metallic bridges, absolute chaos prevails.

Engineers must remember that if satisfactory rules are to be framed, they, and not Governmental departments, must take the initiative. In former days the British Association did much to direct the attention of engineers to this important matter, but, so far as I know, the subject has been dropped for the past twenty years, and I have ventured, therefore, to bring it before you again in some detail. We are here avowedly for the advancement of science, and I have not been deterred by the dryness of the subject from soliciting your attention to a branch of science which is sadly in need of advancement.

Had I been addressing a less scientific audience I might have been tempted rather to boast of the achievements of engineers than to point out their shortcomings. The progress in [illegible] branches of mechanical science during the past fifty [illegible] exceeded the anticipation of the most far-seeing. [illegible] ago the [illegible] the Stockton and Darlington Rai[illegible] asked [illegible] committee if he thought [illegible] impro[illegible] on railways, repli[illegible] under[illegible] would have a [illegible] work b[illegible] embankme[illegible] neighbou[illegible] perfection [illegible] that a year's experience showed the saving in horseflesh to be fully 33 per cent.

Although these views seem childlike enough from our present standpoint, I have no doubt that as able and enterprising engineers existed prior to the age of steam and steel as exist now, and their work was as beneficial to mankind, though different in direction. In the important matter of water supply to towns, indeed, I doubt whether, having reference to facility of execution, even greater works were not done 2000 years ago than now. Herodotus speaks of a tunnel 8 feet square, and nearly a mile long, driven through a mountain in order to supply the city of Samos with water; and his statement, though long doubted, was verified in 1882 through the abbot of a neighbouring cloister accidentally unearthing some stone slabs. The German Archæological Society sent out Ernst Fabricius to make a complete survey of the work, and the record reads like that of a modern engineering undertaking. Thus, from a covered reservoir in the hills proceeded an arched conduit about 1000 yards long, partly driven as a tunnel and partly executed on the "cut and cover" system adopted on the London underground railway. The tunnel proper, more than 1100 yards in length, was hewn by hammer and chisel through the solid limestone rock. It was driven from the two ends like the great Alpine tunnels, without intermediate shafts, and the engineers of 2400 years ago might well be congratulated for getting only some dozen feet out of level and little more out of line. From the lower end of the tunnel branches were constructed to supply the city mains and fountains, and the explorers found ventilating shafts and side entrances, earthenware socket-pipes with cement joints, and other interesting details connected with the water-supply of towns.

In the matter of masonry bridges, also, as great works were undertaken some centuries ago as in recent times. Sir John Rennie stated, in his presidential address at the Institute of Civil Engineers, that the bridge across the Dee at Chester was the "largest stone arch on record." That is not so. The Dee Bridge consists of a single segmental arch 200 feet span and 42 feet rise; but across the Adda, in Northern Italy, was built, in the year 1377—more than 500 years ago—a similar segmental arch bridge of no less than 237 feet span and 68 feet rise. Ferario not long since published an account of this, for the period, colossal work, from which it would appear that its life was but thirty-nine years, the bridge having been destroyed for military reasons on December 21, 1416. I believe our American cousins claim to have built the biggest existing stone arch bridge in the world—that across the Cabin Johns Creek; but the span, after all, is only 215 feet, or 10 per cent. smaller than the 500-year-old bridge. In timber bridges, doubtless, the Americans will ever head the list, for the bridge of 340 feet span built across the Schuylkill three-quarters of a century ago will probably never be surpassed. Our ancestors were splendid workers in stone and timber, and, if they had been in possession of an unlimited supply of iron and steel I fear there would have been little left for modern bridge-builders to originate.

The labours of the present generation of engineers are lightened beyond all estimate by labour-saving appliances. To prove how much the world is indebted to students of this branch of mechanical science, and how rapid is the development of a really good mechanical notion, it is only necessary to refer to the numerous hydraulic appliances of the kind first introduced forty years ago by a distinguished past-President, Sir W. G. Armstrong. Addressing you in 1854, Sir William Armstrong explained that the object he had in view from the first was "to provide, in substitution of manual labour, a method of working a multiplicity of machines, intermittent in their action and extending over a large area, by means of transmitted power, produced by a steam-engine and accumulated at one central point." The number of cases in which this method of working [illegible] a desideratum, or even indispensable, would appear to be [illegible] I should be sorry, indeed, to have anything to do [illegible] the Forth Bridge if hydraulic appliances were not [illegible] a giant's work. Let me shortly describe to you [illegible] there at the present time. More than 42,000 [illegible] and bars have to be bent, planed, drilled, [illegible] before or after erection, and hydraulic [illegible]out. The plates are handled in the [illegible] hydraulic cranes of special design, [illegible]tiplying sheaves, the whole arm [illegible] direct-acting ram of 6 feet [illegible] 60 miles of steel plates, ranging in thickness from $1\frac{1}{4}$ inches to $\frac{5}{8}$ inch, have to be bent to radii of from 6 feet to 9 inches, which is done in heavy cast-iron dies squeezed together by four rams of 24 inches in diameter, and the same stroke. With the ordinary working pressure of 1000 lbs. per square inch, the power of the press is thus about 1750 tons. Some 3000 pieces, shaped like the lid of a box, 15 inches by 12 inches wide, with a 3-inch deep rim all round, were required to be made of $\frac{5}{8}$-inch steel plate, and this was easily effected in two heats by a couple of strokes of a 14-inch ram. In numberless other instances steady hydraulic pressure has been substituted by Mr. Arrol, our able contractor, for the usual cutting and welding under the blacksmith's hammer.

Hydraulic appliances are also an indispensable part of the scheme for erecting the great 1700 feet spans. Massive girders will be put together at a low level, and be hoisted as high as the top of St. Paul's Cathedral by hydraulic power. Continuous girders, nearly a third of a mile in length, will be similarly raised. Not only the girders, but workmen, their sheds, cranes, and appliances will be carried up steadily and imperceptibly as the work of erection proceeds, on platforms weighing in some instances more than 1000 tons. It is hardly necessary to say that every rivet in the bridge will be closed up by hydraulic power, the machines being in many instances of novel design, specially adapted to the work. Thus the bed-plates, which in ordinary bridges are simple castings, in the Forth Bridge are necessarily built up of numerous steel plates, the size of each bed-plate being 37 feet long by 17 feet 6 inches wide. To grip together the 47 separate plates into a solid mass, 3800 rivets $1\frac{1}{4}$ inches in diameter with countersunk heads on both sides are required, and, remembering that the least dimension of the bed-plate is 17 feet 6 inches, it will be seen that the ordinary "gap"-riveter would not be applicable. A special machine was therefore designed by Mr. Arrol, consisting of a pair of girders and a pair of rams, between which the bed-plate to be riveted together lies. A double ram machine had for like reasons to be devised for riveting up the great tubular struts of the bridge.

Not merely in the superstructure, but in the construction of the foundations, were hydraulic appliances of a novel character indispensable at the Forth Bridge. Huge wrought-iron caissons or cylinders, 70 feet diameter and 72 feet high, were taken up and set down as readily as a man would handle a bucket. In sinking these caissons through the mud and clay of the Forth compressed air was used. When the boulder-clay was reached the labour of excavating the extremely hard and tenacious material in the compressed-air chamber proved too exhausting, pick-axes were of little avail, and the Italian labourers who were chiefly employed lost heart over the job altogether. But a giant power was at hand, and only required tools fit for the work. Spades with hydraulic rams in the hollow handles were made, and, with the roof of the compressed air-chamber to thrust against, the workmen had merely to hold the handle vertically, turn a little tap, aud down went the spade with a force of three tons into the hitherto impracticable clay as sweetly as a knife into butter. Probably, when addressing you thirty years ago, Sir William Armstrong never anticipated that a number of hydraulic spades would be digging away in an electrically lighted chamber or diving-bell, 70 feet diameter and 7 feet high, 90 feet below the waves of the sea; but still the spades come strictly within the definition of the class of machines, intermittent in their action and extending over a large area, which it was his aim to introduce. It would be possible, indeed, with the appliances at the Forth Bridge, to arrange that the simple opening of a valve should start digging at the bottom of the sea, riveting at a height of nearly 400 feet above the sea, and all the multifarious operations of bending, forging, and hoisting, extending over a site a mile and a half in length.

It would not only be impossible to build a Forth Bridge, but it would be equally impossible to fight a modern ironclad without the aid of hydraulic appliances. Most of the Presidents of this Section have referred in the course of their addresses to our navy, and certainly the subject is a tempting one, for the progress of mechanical science in recent years could not be better illustrated than by a description of the innumerable appliances which go to the making and working of a modern ironclad. Let me quote a single passage from a pamphlet by a naval officer, which caused a great stir a few years before the Crimean war, that I may recall to your minds what was the speed and what the armament of our fleet at that comparatively recent period. "Conceive," said Capt. Plunkett, R.N., "a British and French fleet issuing simultaneously from Spithead and

Cherbourg; seven hours' steaming at the rate of six miles an hour will bring them together. A single glance at the heavy and well-appointed tiers of a line-of-battle ship's guns will satisfy any one that they are no toys to be placed in the hands of novices. Formidable batteries of the heaviest ordnance are there—not a gun under a 32-pounder, and many 68-pounder shell guns." In little more than a quarter of a century engineers have changed all that, and advanced to 20-knot vessels and 120-ton guns. Archæologists tell us that our predecessors in mechanical science of the Stone Age were apparently a thousand or more years in finding out that the best way of fitting an axe was to slip the handle through the axe and not the axe through the handle. Engineers of the present day may be excused, therefore, for occasionally illustrating the rapidity of the advance of their science by contrasting the ships of thirty years ago with our modern ironclads.

The latest type of battle-ship weighs, fully equipped, about 10,000 tons. There are about 3400 tons of steel in her hull, apart from armour, which, with its backing, will weigh a further 2800 tons. The machinery, largely of steel, is about 1400 tons; the armament, including ammunition, 1100 tons; the coals, 1100 tons; and general equipment, 270 tons. A detailed description bristles with the word "steel," and enthusiastic newspaper reporters sent down to Chatham Dockyard can no more "spin out their copy" with Cowper's oft-quoted lines on the "Launch of a First-Rate":—

> "Giant oaks of bold expansion
> O'er seven hundred acres fell,
> All to build thy noble mansion,
> Where our hearts of oak do dwell."

A latter-day poet might boast of 700 acres being exhausted by a single vessel, but it would be a coal-field and not a forest. Accepting Prof. Phillips's estimate of the average rate of formation of coal, it may be shown that a hard-worked American liner during her lifetime burns as much coal as would be produced on the area of 700 acres in a period of 2000 years. We are thus with our steel ships using up our primeval forests at a far more extravagant rate than that at which our immediate forefathers cleared the oak forests. Coal is the great stimulant of the modern engineer. Pope Pius the Second has left on record an expression of the astonishment he felt when visiting Scotland, in the fifteenth century, on seeing poor people in rags begging at church doors, and receiving for alms pieces of black stone, with which they went away contented. To such early familiarity with coal may, however, be due the fact that Scotland has ever led the way in the development of the steam-engine, and that at the date of the battle of Waterloo she had built and registered seven steam-vessels, whilst England could boast of none.

Probably none but a poet or a painter would wish for a return to our old oak sailing ships. Some few people still entertain the illusion that the picturesque old tubs were better sea-boats than our razor-ended steamers; but, speaking of them in 1846, Admiral Napier said: "The ships look very charming in harbour, but to judge of them properly you should see them in a gale of wind, when it would be found they would roll 45° leeward and 43° windward." Even our first ironclads were not so bad as that, for although, according to the *Times*, when the squadron was on trial in the Bay of Biscay, the ships rocked wildly to the rising swell and the sea broke in great hills of surf, yet the maximum roll signalled by the worst roller of the lot—the *Lord Warden*—was but 35° leeward and 27° windward—a total range of 62° as compared with 88° in the old line-of-battle ships.

We have heard much about the state of the navy [illegible] twelve months. A dip into the publications of th[illegible] ciation—which in this, as in other respects, aff[illegible] tion of what is uppermost in people's minds—[illegible] similar discussions have recurred periodically, at [illegible] 1830. If we consult Hans[illegible] I had occasion [illegible] we find the same remark [illegible] periods long [illegible] 1830.

It amounts almost to a [illegible] in the mind [illegible] Briton that Providence w[illegible] at least equal to that o[illegible] would be said now of a M[illegible] administration of the navy by [illegible] as many line-of-battle ships as Ru[illegible] none less than fifty years ago. Sp[illegible] as on March 4, 1839, the Secreta[illegible]

"For the last six months unceasing attacks have been made upon our naval administration, describing our navy as in a state of the utmost decrepitude, and Tory papers say that shameful reductions have been made in the navy by the present Government. It will be a consolation to my honourable friends to be assured that we have for years lived unharmed through danger as great as that to which we are now exposed. In 1817 we had [illegible] sail-of-the-line in commission, and Russia had 30; in 1825 we had 12, and Russia 37; in 1832 we had 11, and Russia 36; and now we have 20, and the Russians 43, having raised our [illegible] to nearly half the number of those of Russia."

Now as to our guns. The past twelve months is by no means the first occasion on which the armament of our navy has been attacked. Three years subsequent to the speech of the Secretary of the Admiralty just referred to, Sir Charles Napier made a statement from his place in Parliament of so extraordinary a character that I make no apology for quoting his exact words as a reminder of the past and a warning for the future: "At the end of the last war the guns were in such a bad state that, if fired, they would scarcely hit an enemy, and during the [illegible] period of the American war a secret order was issued that British ships of war should not engage American frigates, because the former were in such an inefficient state." As to [illegible] self, said the plain-spoken old admiral, when he got the [illegible] he put it in "the only place fit to receive it, the [illegible] galley."

Happily, from our insular position, the change which the progress of mechanical science has wrought in military operations has not been brought home to the people of this country in the vivid manner that it has to the people of the continent of Europe and America. In the American war, the Franco-German war, and the Russo-Turkish war the construction and equipment of railway works by engineers was an essential feature of all great movements. The Russians, in 1877, constructed a railway from Bender to Galatz, 180 miles in length, in [illegible] working days, or at the rate of more than three miles [illegible] Altogether, in the three latter months of that year they [illegible] and built about 240 miles of railway, and purchased [illegible] the line with 110 locomotives and 2200 waggons. They built numerous trestle bridges, together with an opening [illegible] and a ferry across the Danube.

We have had recent experience of the slowness of primitive modes of transport in the tedious advance of Lord W[illegible] handful of men in whale-boats up the Nile. It was the [illegible] tion of the late Khedive, partly from military and partly from commercial considerations, to construct a railway exactly [illegible] line of advance subsequently followed by Wolseley. M[illegible] ner, Mr. Fowler, had the railway sent out in 1873, and the [illegible] were shortly after commenced. The total length was 55[illegible] and the estimated cost, including rolling-stock and [illegible] shops, 4,000,000*l*. Owing to financial difficulties the works were abandoned, but the 64 miles constructed by Mr. Fowler, and recent extensions of the same by the military, proved of [illegible] service to the expedition, even some of the steam-launches [illegible] taken by railway to save delays at the cataracts.

During the siege of Paris the German forces were dependent upon supplies drawn from their base, and the army requirements were fully met by one line of railway running twelve to [illegible] trains per day. Military authorities state that a train [illegible] about 250 tons is equal to two days' rations and corn for an army corps of 37,000 men and [illegible] The military [illegible] tions in Egypt have proved [illegible] in the heart of [illegible] railways, steamboats, elec[illegible] machine guns, and [illegible] offspring of mechanical [illegible] essential ingredients [illegible]

Members of this Section w[illegible] [illegible] not for the first time [illegible] and European engi[illegible] points of differen[illegible] more than [illegible] the cha[illegible] forged [illegible]

[illegible]

American in construction, whilst for girders of moderate span, such as those on the many miles of elevated railway in New York, riveted girders of purely European type are admittedly the cheapest and most durable. From my conversations with leading American bridge builders, I am satisfied that their future practice and our own will approach still more nearly. We should never think of building another Victoria tubular bridge across the St. Lawrence, or repeat the design of the fallen Tay Bridge, nor would they again imitate in iron an old timber bridge, or repeat the design of the fallen Ashtabula bridge. In one respect the practice in America tends to the production of better and cheaper bridges than does our own practice, and it is this: each of the great bridge-building firms adopts by preference a particular type design, and the works are laid out to produce bridges of this kind. It is an old adage that practice makes perfect, and by adhering to one type, and not vaguely wandering over the whole field of design, details are perfected and a really good bridge is the result. Engineers in America therefore need only specify the span of their bridge, and the rolling load to be provided for, with certain limiting stresses, and they can make sure of obtaining a number of tenders from different makers of bridges, varying somewhat in design, but complying with all the requirements. With us, on the other hand, it is too often the privilege of a pupil to try his 'prentice hand on the design for a bridge, and it is no wonder, therefore, that many curious bits of detail meet the eye of an observant foreigner inspecting our railways.

The magnificent steel wire rope suspension bridge of 1600 feet span built by Roebling across the East River at New York well marks the advanced state of mechanical science in America as regards bridge-building. It is worthy of note that, at the second meeting of the British Association, held so long back as 1832, there was a paper on suspension bridges, and the author entreated the attention of the scientific world, and particularly of civil engineers, to the serious consideration of the question: "How far ought iron to be hereafter used for suspension bridges, since a steel bridge of equal strength and superior durability could be built at much less cost?" "I earnestly call upon the ironmasters of the United Kingdom," said he, "to lose no time in endeavouring to solve this question." In this, as in many other engineering matters, America has given us a lead. America, is indeed, the paradise of mechanics. When the British Association was inaugurated, years ago, there was, I believe, no intention to have a section for the discussion of mechanical science. Possibly it may have been considered too mean a branch. Even the usually generous Shakespeare speaks contemptuously of "mechanic slaves, with greasy aprons, rules, and hammers;" and our old friend Dr. Johnson's definition of "mechanical" is "mean, servile." We have lived down this feeling of contempt, and the world admits that the "greasy apron" is as honourable a badge as the priest's cassock or the warrior's coat of mail, and has played as important a part in the great work of civilising humanity and turning bloodthirsty savages into law-abiding citizens.

As I have had occasion to refer to Canada and America in the course of my remarks, I cannot refrain from expressing the high appreciation which I am sure every member of this Section entertains of the cordiality and warmth of our reception on the other side of the Atlantic last year. Such incidents make us forget that differences have ever existed between the two countries. I was amused the other day, on reading in Dr. Doran's "Annals of the Stage," that, in the year 1777, the theatrical company from Edinburgh was captured on its voyage to Aberdeen by an American privateer, and taken off Heaven [illegible] where, for it did not turn up again. This, you will say, [illegible] long time ago; but, if you glance through the speeches of [illegible] present gracious Sovereign, you will find one in which her [illegible] with "deep concern" of insurrection in Lower [illegible] hostile incursions into Upper Canada by [illegible] inhabitants" of the United States of North [illegible]

[illegible] after our last year's experience. [illegible] have carried you with me in some things [illegible] will all agree with me in this: that [illegible] suffer any slight difference of opinion [illegible] breach between ourselves and our [illegible] in America would, to quote the [illegible] qualified to be directors of the [illegible] not fit even to turn a wheel

## *NOTES*

The new gallery of fishes at the Natural History Museum is now open to the public, and an addition has been made to the Osteological Gallery by throwing open the pavilion at the west end, in which are exhibited skeletons and skulls of elephants, the giraffe, &c.

A report is current in Rome that the members of the Italian Expedition to Central Africa, under the leadership of Signor Alfredo Massari, have been massacred.

The natural history collections made by the late Dr. Nachtigal, in the course of his tour of annexation on the west coast of Africa, have arrived at Berlin in twenty cases, and the greater part of their contents will be assigned to the new ethnological museum.

An astronomical-mathematical section, under the presidency of Profs. Reye and Christoffel, of Strassburg, has been formed in the Scientific Congress at Strassburg.

M. Bouquet, a mathematician of some eminence and a Sorbonne professor, died on the 10th instant at the age of sixty-six.

The death is announced of Mr. W. A. Guy, M.B., F.R.S., on the 10th inst., in the seventy-sixth year of his age. He was for a number of years Dean of the Medical Department in King's College, and Professor of Hygiene. He was admitted a Fellow of the Royal College of Physicians in 1844, held office as censor in 1855, 1856, and 1866, and as examiner in 1861–3, and in 1861, 1868, and 1875 was appointed Croonian, Lumleian, and Harveian lecturer. Mr. Guy also held a number of other appointments, among which were—honorary secretary to the Statistical Society in 1845, and President in 1873, examiner in forensic medicine at the University of London in 1862, Swiney Prizeman, 1869, and Vice-President of the Royal Society in 1876-7. Mr. Guy devoted much attention for many years to questions of sanitary reform and social science, and in 1878 was appointed one of the Royal Commissioners to inquire into the working of the Penal Servitude Acts; also in 1879 a member of the Criminal Lunatic Commission. He was the author of many essays on physiology and kindred subjects, and also of works of a more general character. Among his principal publications may be mentioned "Principles of Forensic Medicine," "Public Health," "The Factors of the Unsound Mind," "John Howard's Winter's Journey," and his last work, "The Claims of Science on Public Recognition and Support." It may be added that Mr. Guy was likewise editor of Hooper's "Physician's Vade-Mecum."

Col. Prejevalsky has sent the following message, dated July 1, from his camp in Chinese Turkestan:—"It is impossible to penetrate into Tibet by the Keria Mountains, the passes through them being impracticable for our beasts of burden, and the Chinese having obstructed the paths with rocks, and having also destroyed the bridges. The native population has given us everywhere a good reception, and, despite the interference of the Chinese, their sympathies with the Russians are openly pronounced. We shall pass the present month among the snow-covered mountains between the rivers of Keria and Khoten. About the middle of August we shall go to Khoten, and then by the course of the river of the same name to Aksu. All is well."

The inaugural address at the commencement of the medical session 1885-86 will be delivered at St. Thomas's Hospital on October 1, at 3 p.m., by A. O. MacKellar, M.Ch., F.R.C.S., in the theatre of the hospital.

At the request of the Batavian Society of Arts and Sciences, the Government of the Netherlands' Indies has taken a step which might be imitated by other Governments with advantage. It has distributed fifty copies of Prof. de Hollander's "Handleiding bij de Beoefening der Land- en Volkenkunde von Neder. Oost Indië" to its officials in all parts of its colonies, and has instructed them to compare their own observations with the statements in the work, and to report the result.

THE German Government has despatched a mission under Baron Pring to the Cheshire salt districts, charged with an investigation of the local industry, and especially of the phenomenon of land subsidence through brine pumping, Prince Bismarck being about to propose certain legislation affecting similar landslips in Germany.

WITH reference to Mr. G. J. Symons's letter last week on the subject of the trees in Richmond Park struck by lightning, Mr. Percy Smith writes to the *Times* that "the most probable cause of the liability of certain trees to be struck by lightning is that they are bad conductors of electricity. The suggestion that oak trees are struck because they contain iron is both erroneous and absurd. If oak did contain iron it would in all probability increase its conducting power and act as a preservative. If oak contained an estimable quantity of that metal the wood would turn black on exposure to air, on account of the tannin which is present. This blackening may be seen surrounding the iron nails in any oak fence. The contour of the ground, nature of the soil, and the presence or absence of water has more influence in deciding the locality of an electric discharge than the height of a tree. Add to this the difference in conductibility between various woods and we have at once an explanation of the apparent peculiarity of tall trees escaping unharmed while shorter trees are destroyed."

ONE of the proofs commonly advanced for the theory that the cold in northern regions has increased in historic times is that there is an increase of ice on the eastern shores of Greenland; another is that barley, which was successfully grown in Iceland from its first settlement in 870 down to the middle of the fifteenth century, is no longer cultivated there. It is, therefore, of much interest to learn from *Globus* that the Icelandic Government lately attempted to grow barley in the island on a considerable scale, and that the results were very favourable. Norwegian barley from Altenfjord, which is on the extreme north of the barley-growing zone, was planted and was fit for cutting down in eighty-nine days. The decline in the cultivation of barley in Iceland was really due, not to an increase in the cold, but to the fact that cattle-breeding paid better. Attempts are being made to grow other plants: at Reikjavik a botanical garden has been established, and the seeds of 382 kinds of plants which occur around Christiania have been planted there. It is probable, therefore, that the scanty garden flora of Iceland will be increased in the near future.

AT the recent meeting of the French Association at Grenoble M. de Mortillet read a paper on Tertiary man before th[e] anthropological section. The question, he said, was not t[o] know whether man already existed in the Tertiary epoch as he exists at the present day. Animals [illegible] one geological stratum to another, and the higher [illegible] the greater was the variation. It was to be inferr[ed] [illegible] man would vary more rapidly than the other [illegible] was to discover in the Tertiary period [illegible] a predecessor of the man of historica[l] [illegible] affirmed that there were unquestionab[ly] [illegible] objects which implied the existence o[f] [illegible] These objects have, in fact, been found a[t] [illegible] of the Tertiary epoch—in the lower Tertiary [illegible] the Upper Tertiary at Otta, in Portugal, and at [illegible] Cantal. These objects proved that at these two [illegible]

there existed in Europe animals acquainted with the use of fire and able more or less to cut stone. During the Tertiary period, then, there lived animals less intelligent than existing man, but much more intelligent than existing apes. M. de Mortillet gave the name of *anthropitheque*, or ape-man, to the species, which he maintains, was an ancestral form of historic man, whose skeleton has not yet been discovered, but who has made himself known to us in the clearest manner by his works. A number of flints were exhibited from the strata in question, which had been intentionally chipped and exposed to fire. The general opinion of the *savants* assembled at Grenoble was that there can be no longer any doubt of the existence in the Tertiary period of an ancestral form of man.

AN ingenious instrument for ascertaining the distances of accessible and inaccessible points from the observer and from each other has been invented by Dr. Luigi Cerebotani, a Professor of the University of Verona. This apparatus consists mainly of a pair of telescopes mounted on a stand and fixed on a tripod for use. The telescopes are both brought to bear on the object, and a reading is then taken from a graduated scale on the instrument, which, compared with a set of printed tables gives the distance. By this means the inventor obviates the necessity for the base line, which has hitherto had to be laid down in these operations, and he dispenses with all trigonometrical calculations. Distances can be measured between far-off objects, and, by means of a sheet of paper fixed on a drawing board, a rough plan of the country under measurement can be sketched. In the same way the distances of ships at sea or of moving objects on land can be determined. The apparatus appears to be well adapted for land-surveying, and particularly for military purposes. In fact, it is stated to have been already adopted in the German army in the latter connection, and is about to be tried by the authorities of our own War Department. A practical trial was made with this instrument on the Thames Embankment on the 11th inst., when its varied usefulness was demonstrated.

WE have received from the Director of the Batavia Observatory a volume containing statistics of the rainfall in the East Indian Archipelago for the year 1884. Rainfall observations were made during the year at 145 stations without interruption, although at the end of the year there were 172 stations, 94 of which were on the islands of Java and Madura.

IT is stated that the Physical and Mathematical Society of Tokio has decided in future to print its official proceedings in Japanese written in Roman letters instead of Chinese characters, although the authors of papers may employ any style of language they please. A similar step is in contemplation by the Japanese Chemical Society.

[illegible] in a late issue of the [illegible] the U[illegible] Commission, Prof. Ve[illegible] the [illegible] oysters will live ov[illegible] Haven his attenti[on] [illegible] attached to an o[illegible] December to [illegible] he [illegible] larger oysters [illegible] small[er] [illegible] the case [illegible] chipped. [illegible] front edge [illegible] position—suspended as they were with the front edge downward—is the most favourable one possible for the retention of water within the gill-cavity, for in this position the edges of the mantle would closely pack against the inner edges of the shell, effectually closing any small leaks, and the retained water would also be in the most favourable position to moisten the gills, even after part had evaporated. It is also possible that when in this position the oyster instinctively keeps the shell tightly closed, to prevent the loss of water. This incident, says Prof. Verrill, may give hint of the best mode of transporting oysters and clams long distances. Perfect shells should be selected, and they should be packed with the front edge downward, and kept moderately cool, in a crate or some such receptacle which will allow a free circulation of air. Under such favourable conditions selected oysters can doubtless be kept from eight to twelve weeks out of water. Mr. Ryder, of Washington, adds that he has had oysters live in the shell for two weeks, where the temperature ranged from 30° to over 80° F., lying on shelves in the cases in his work-room, exposed the whole time to the air, without showing the slightest tendency to decompose.

THE schooner *Rosario*, at New York, reports than on June 23, in lat. 29° 14′ N. and long. 133° 25′ W., at 11 a.m., two heavy shocks of submarine earthquake were experienced. These were about one minute apart, and the last was much heavier than the first, causing the vessel to tremble violently. The sky was overcast, and the sea remarkably smooth.

THE Russian Geographical Society is said by the St. Petersburgh journals to contemplate sending a scientific expedition to the Amour for the purpose of studying the surrounding region with regard to its geographical, historical, and commercial features, as well as its mineral resources.

IT is announced in Brussels that the German Lieutenant Weissmann, who is in the service of the African Association, has discovered that the River Kassai, which was always believed to join the Congo above the equator station, forms a curve and falls into Lake Leopold II.

ON the night of August 31 to September 1 temperature fell to a lower point in several districts than is known to have ever before happened so early in the season. Over upper and middle Strathspey in particular the frost was very severe. At Kingussie the protected thermometer fell to 24°·9 and the exposed to 18°·0, while at Grantown the exposed thermometer fell to 15°·0, these being all compared instruments and in good order. At Kingussie ice an inch thick was found on the water supplying the hygrometer. In this large district the potato crop is completely destroyed, not only in low-lying situations but also on the high-lying slopes. On the other hand, on crossing from Inverness-shire into Perthshire, the potato crop is safe, the tops being only slightly blackened. At the Ben Nevis Observatory on the same night, with a sky equally clear and cloudless as was over Strathspey, the protected thermometer fell only to 32°·9 and the exposed thermometer to 24°·6, being respectively 8°·0 and 6°·6 [illegible]er than occurred at Kingussie on the same night.

[illegible] additions to the Zoological Society's Gardens during the [illegible]k include a Barbary Ape (*Macacus inuus*) from North [illegible] by Miss Bedford; at Bank Vole (*Arvicola* [illegible]), presented by Mr. E. Rosling; a Common [illegible] (*[illegible] europæus*), British, presented by Master [illegible] Common Polecat (*Mustela putorius*), British, [illegible]ckley; an Undulated Grass Parrakeet [illegible] from Australia, presented by Mdlle. [illegible] (*[illegible] lævis*) from Dorsetshire, [illegible] P. Cambridge, C.M.Z.S.; two [illegible] (*[illegible] douglassi*) from New [illegible] Shufeldt; two Common [illegible] North Africa, presented [illegible]

## *ASTRONOMICAL PHENOMENA FOR THE WEEK*, 1885, *SEPTEMBER* 20-26

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on September* 20

Sun rises, 5h. 44m.; souths, 11h. 53m. 16·2s.; sets, 18h. 2m.; decl. on meridian, 0° 56′ N.: Sidereal Time at Sunset, 18h. 1m.

Moon (Full on Sept. 24) rises, 16h. 21m.; souths, 21h. 21m.; sets, 2h. 27m.*; decl. on meridian, 12° 12′ S.

| Planet | Rises | Souths | Sets | Decl. on meridian |
|---|---|---|---|---|
| | h. m. | h. m. | h. m. | ° ′ |
| Mercury ... | 4 1 | 10 50 | 17 39 | 8 51 N. |
| Venus ... | 9 12 | 14 7 | 19 2 | 13 11 S. |
| Mars ... | 0 23 | 8 21 | 16 19 | 20 42 N. |
| Jupiter ... | 4 52 | 11 23 | 17 54 | 5 21 N. |
| Saturn ... | 22 27* | 6 35 | 14 44 | 22 20 N. |

* Indicates that the rising is that of the preceding and the setting that of the following day.

*Occultations of Stars by the Moon*

| Sept. | Star | Mag. | Disap. | Reap. | Corresponding angles from vertex to right for inverted image |
|---|---|---|---|---|---|
| | | | h. m. | h. m. | ° ° |
| 20 | 18 Aquarii | 6 | 18 47 | 19 55 | 49 305 |
| 21 | B.A.C. 7774 | 6 | 22 8 | 23 22 | 136 283 |
| 24 | B.A.C. 8365 | 6½ | 5 12 | 6 5 | 124 350 |
| 25 | μ Piscium... | 5 | 20 12 | 21 9 | 94 233 |
| 26 | B.A.C. 741 | 6½ | 21 19 | 22 3 | 26 299 |

The Occultations of Stars are such as are visible at Greenwich.

| Sept. | h. | |
|---|---|---|
| 20 | 8 | Mercury at least distance from the Sun. |
| 22 | – | Sun in equator. |
| 24 | – | Partial eclipse of the Moon, but the Moon will set at Greenwich at about sunrise whilst partly obscured by the penumbra and before entering the shadow. |

## *SCIENTIFIC SERIALS*

*The Proceedings of the Royal Society of Queensland*, 1884, vol. i. parts 2, 3, 4.—We are glad to see that this new Society in one of our leading colonies is advancing rapidly. In the parts before us Mr. Tryon describes certain rock-drawings of the aborigines of Queensland, of a class hitherto undescribed (with plates). Mr. C. W. de Vis, who is one of the most indefatigable contributors, writes on new Australian lizards; on a new form of the genus Therapon; on new Queensland lizards; on a new species of Hoplocephalus; on an apparently new species of Halmaturus; on a new species of Hyla; a description of new snakes with a synopsis of the genus Hoplocephalus; on the fauna of the Gulf of Carpentaria, and a conspect of the genus Heteropus. Mr. Bailey gives instalments of his contributions to Queensland Flora. Mr. Broadbent writes on the migrations of birds at the Cape York peninsula, which is a peculiarly favourite spot for observing the migrations of birds from and to New Guinea, for the passage is shortest here. Ethnology is well represented in the numbers before us, for, besides the paper by Mr. Tryon mentioned above, we have one by Dr. Bancroft on the food of the aborigines of Central Australia, and one by Mr. Duffield on the inhabitants of New Ireland and its archipelago, their fine and industrial arts, customs, and language, especially their tattooing. Mr. Knight describes a new species of Parmelia, and Baron von Müller, the *Dendrobium cincinnatum*, sp. nov. Mr. Bernays describes exotic fruits new to Queensland. Mr. Pink pleads for the practice of hybridisation of plants; and Dr. Bancroft describes experiments with Indian wheats in Queensland. There are numerous other minor contributions.

## *SOCIETIES AND ACADEMIES*

### PARIS

**Academy of Sciences**, August 31.—M. Bouley, President, in the chair.—On the cyclonic character of the solar spots, in reply to M. Tacchini's objection, by M. Faye. In their normal state the spots, like terrestrial cyclones, are described as of circular form, with funnel-shaped penumbra, concentric circumferences, and vertical axis, varying in size from almost imperceptible pores to abysses large enough to engulph the earth. The mechanical identity of the two phenomena is thus established, while the absence of this special disposition in the penumbra of certain spots proves nothing against the author's theory, which accounts both for the development and occasional disappearance of the cyclonic form.—Note respecting M. Bochefontaine's experiment on the origin of cholera, by M. Trécul. A pill containing the comma bacillus having been swallowed by M. Bochefontaine with impunity, the author infers that Koch's germ may not after all be the active principle of cholera. In any case he protests against the ridicule cast upon the experimenter, whose courageous act is worthy rather of admiration and reward.—On the part played by the bacilli in the ravages of the vine attributed to *Phylloxera vastatrix*, by M. Luiz de Andrade Corvo. From his experiments the author concludes that the disease, to which he gives the name of "tuberculosis," is quite distinct from, and independent of, Phylloxera, that it is constitutional and hereditary, and may also be transmitted by contagion, the insect merely playing a secondary part in its propagation.—Octahedrons of sulphur with square base, which is physically a rhombus, by M. Ch. Brame.—On certain points in the physiological action of tanguin, the poison used at ordeals in Madagascar, by M. Ch. E. Quinquand.—Influence of the sun on the vegetation, the vegetable functions and virulence of the cultivated virus of *Bacillus anthracis*, by M. S. Arloing.—A letter was read by the Perpetual Secretary from King Oscar of Sweden, to the effect that on attaining his sixtieth year, in 1889, he proposes offering a prize of 2500 francs, with a gold medal valued at 1000 francs, to the author of the most important contribution to mathematical science. The already nominated judges are a German, a Swiss, and M. Hermite of the Academy. —Experiments with various kinds of wheat, with a view to ascertain the most productive variety under normal conditions, by M. P. P. Dehérain. Five varieties yielded the following returns per hectare (2½ acres):—

| | Corn | | Straw |
|---|---|---|---|
| | Quintals | Hectolitres | (Tons) |
| Scholey | 40·7 | 49·8 | 7·323 |
| Scotch red | 40·2 | 48·7 | 7·687 |
| Berwick | 37·7 | 44·8 | 6·281 |
| Bordeaux | 32·3 | 39·8 | 5·630 |
| Noé Blue | 29·6 | 35·6 | 5·491 |

—Account of a meteor observed at Fontainebleau, by M. E. P. Mounier. This meteor was noticed at 7.20 a.m. in a clear sky, describing a parabolic curve from north to south at a velocity much inferior to that of a shooting star. It emitted an intensely white light like that produced by a magnesium wire in combustion. Before disappearing it broke into three fragments, which for an instant flared with a still more vivid light, and then suddenly became extinguished.

BERLIN

**Physiological Society**, July 3.—Prof. Waldeyer reported on an investigation carried out in his institute by Herr Fischelis into the development of the thyroid gland. The oldest observers, Remak, Kolliker, and, quite recently, His, had found that the thyroid gland was developed medianly from the stomodæum, a thickening of the wall and then a buttonlike eminence arising thereon, which afterwards became hollow and got transformed into the gland. Seeing the gland was composed of two lateral lobes united by an intermediate piece, Herr His assumed that two protrusions arose from the anterior wall of the stomodæum, coalescing towards the middle. Herren Stieda and Wolfler had afterwards given an entirely different description of the development of this organ. According to them the thyroid gland was developed from two lateral buds emanating from the branchial cleft, probably from the fourth fissure. In view of this contradiction of authors Herr Born had quite recently resu[illegible] this investigation, and had come to the highly surprising [illegible]clusion that the thyroid gland originated both medianl[illegible] laterally, the middle part of the gland originating fro[illegible] uppermost part of the stomodæum, the lateral portions fro[illegible] branchial clefts. This fact having no analogy in embryology, [illegible] Fischelis had scrutinisingly traced the development of [illegible] thyroid gland, not only in swine, which had been examined by Herr Born, but also in rabbits and birds. The result was the [illegible] confirmation of Herr Born's conclusions. Thus was [illegible] ground taken from unde[illegible] phylogenetic specu[illegible] regarding the derivation [illegible] [illegible] gland. This organ, which was a complete riddle both physiologically and histologically, remained inexplicable phylogenetically as well. In the discussion which followed, the effects of the excision of the thyroid gland in men and animals were copiously enlarged on.—Prof. Eulenburg spoke on a communication concerning the influence of the cortex of the cerebrum on the temperature of the body, which had been lately laid before the Society by Dr. Raudnitz, and sought to refute the arguments which had been brought forward by the latter in opposition to the conclusions at which, in conjunction with Herr Landois, he (Prof. Eulenburg) had arrived. The speaker maintained both the exactness of the thermo-electric measurements and the accuracy of his statements in reference to phenomena he had observed regarding the influence of certain parts of the cortex cerebri on the temperature of the part of the body lying opposite. His statements were supported not only by experiments on animals by means of stimulation and cutting, but likewise by a large number of clinical experiences. —Dr. Mullenhoff spoke of the different methods of investigating the locomotion of animals, and discussed the advantages afforded in this study by the photographic representation of a large number of individual moments on the part of animals in the act of movement. A rather large series of photographs prepared by Herr Anschutz in Lissa were shown. They reproduced the movements of men and horses, of storks dropping into their nests, lying there, and issuing from them, and pigeons.—Dr. Salomon next exhibited some beautiful preparations of paraxanthine crystals which he had obtained from urine, and set forth some further qualities and reactions of this xanthine body discovered by him a year ago in the urine. Paraxanthine occurred very sparely; one thousand litres of urine contained but one grain of paraxanthine. In just as small quantity was another xanthine body present in urine, a body which he had now discovered and had called provisionally "heteroxanthine." This body was precipitated amorphously in the form of powder or in the shape of poppy-seeds, and with soda formed beautiful crystals. Certain reactions served to discriminate it from paraxanthine and to range it under the head of xanthine bodies. [illegible] quite peculiar interest was its chemical composition. So far as the elementary analysis had yet gone, heteroxanthine was methylxanthine, while paraxanthine was a dimethylxanthine isomeric with theobromine. Seeing, as was known, that coffeine was a trimethylxanthine, by the discovery of the simply methylated xanthine the gap in the series of methylxanthines was filled up. We had now xanthine, methylxanthine = heteroxanthine, dimethylxanthine = paraxanthine and theobromine, trimethylxanthine = coffeine.

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THURSDAY, SEPTEMBER 24, 1885

## PUBLIC OPINION AND STATE AID TO SCIENCE

ALTHOUGH Sir Lyon Playfair's address was probably listened to by a large number of members of the British Association as that of a man of science, there can be no doubt that to the vast majority of people outside it came as the utterance of a practical statesman. It was the Chairman of Committees of the House of Commons, the member of Parliament, the man of affairs who spoke, and the address was largely in keeping with these characters, for, as one writer has expressed it, it smells not so much of the laboratory as of the House of Commons. The subject of the endowment of research, of State aid to science, has been before the public for many years, and has been discussed under various circumstances, but it has never attracted at any one time the same earnest and general attention that it has since Sir Lyon Playfair's address. This is due not less to the pedestal on which the speaker was placed, than to the character and career of the speaker himself. The result has been that the guides and instructors of public opinion all over the country have felt it necessary to address themselves to the subject, and it is therefore possible now to gain some idea of the general drift of the public mind on the question of the claims of science on the State, and of the manner in which these claims should be met. Happily it is a question which men of all shades of opinion can consider without having their vision obscured by party passion and prejudice. As we go on it will be seen that the advocates of the doctrine of *laissez faire* are not absent; but, on the whole, those who have for so long maintained that the country, for the sake of its own happiness and prosperity and in order to maintain its place amongst other nations, must bring the teachings of science to its aid, have every ground for satisfaction.

To gauge public opinion on this question, in some measure, we have taken many of the leading journals of the metropolis, and propose to state briefly their views on this particular part of the Presidential Address. As will be seen, all shades of opinion are represented.

The *Times* acknowledges the reproach that countries less wealthy than our own make efforts to encourage science, by the side of which the encouragement afforded in England to science by the State sinks into insignificance; but it urges that, after all, the State is very much what the individuals who compose it choose to make it. Until public opinion exists in an organised and effective shape, the demand for the encouragement of science by the State will be addressed, for the most part, to a faithless and unbelieving generation. It points, as do a large number of other writers, to our ancient endowments for the benefit of education, and says that, although it may be conceded that they are still largely misapplied, they could be almost indefinitely increased, without direct assistance from the State, if vested interests and lack of intelligent initiative did not so often stand in the way. Until these obstacles are removed by the pressure of an active and enlightened public opinion, the State itself can hardly be expected to do much more than it does. The *Times*, therefore, acknowledges the need, and suggests that it should be met by the proper application of our existing educational endowments.

The *Standard* is as anxious as the President to see our Universities fully, and even lavishly, equipped for the prosecution of research; but it will not allow that they are so miserably starved as he would lead us to believe:—

"Sir Lyon Playfair falls into the vulgar error of reckoning as national expenditure on a given object only the outlay provided from taxation. Our Universities have resources which ought to be set against the State provision made in other countries for the same purposes. We are not, therefore, disposed to join in the outcry against the results of our English system. We believe that private benefactions and private enterprise have done much and are capable of doing more, and doing it better, than the State can do. We are not ashamed of the condition of scientific studies in England, and we claim for our countrymen a leading place among those who have built up the fabric of knowledge and promoted the well-being of man."

The *Daily Telegraph* likewise refers to private munificence which in the past has done in this country what State aid has to do at present in Continental countries, and it urges that scientific people should set before themselves, as their proper aim, to convince public opinion that the teaching of a far greater amount of science is necessary in our schools which are richly enough endowed.

The *Morning Post* maintains that Sir Lyon Playfair has conclusively demonstrated that we do not in respect to scientific education keep abreast of other countries, and in the same proportion as we allow ourselves to be distanced do we deny ourselves the means and the opportunities of developing our industrial and physical resources. The money laid out in the manner indicated by Dr. Playfair, it says, would be well expended, and would in time be returned a hundredfold to the Imperial Exchequer.

The *Daily News* regards the address as singularly interesting and practical. It is a powerful and, as many will think, a conclusive plea for giving science a larger and a better place in modern life. Sir Lyon Playfair is a practical statesman, and suggests only practical measures. We must not only greatly enlarge our educational machinery, but must at the same time modernise it and bring it into direct relation to modern needs.

The *Morning Advertiser* eulogises the address because every word of it is directed to the one moral, "Educate, educate, educate." Never has the cause of scientific education been urged in a manner which commends itself more to common sense and conviction than in the singularly well-reasoned monologue wherein Sir Lyon Playfair, from the platform of the British Association, hits a national danger at the same time that he shows the means of correcting it.

The *Pall Mall Gazette* pronounces a verdict in favour of Sir Lyon Playfair as clearly and decidedly as the *Morning Post*. It says:—

"No one will be surprised that Sir Lyon Playfair should have selected for the subject of his address the 'Relation of Science to the State,' and when that is once explained it goes without saying that he made a very cogent plea for an establishment and endowment of science. This plea, it is perfectly certain, cannot be much longer refused. The Laissez-faire Society must add a new section to it betimes, for it is inevitable that the liberty of ignorance, which is impoverishing the life of the country at home and letting its trade slip through its fingers abroad, should soon be very rudely interfered with by the State. At present it is a case in this matter of Great Britain *contra mundum*. Every other civilised country has come to the conclusion by this time that the competition of the world is now a competition of intellect, and has taken steps accordingly. Either we or they must be wrong; and that it is we is now being brought home to us by the conclusive 'argument to the pocket.' John Bull's one ambition, according to Mr. *Punch*, is to 'guard his pudding;' but then he is beginning to find out that he can only fill his stomach by first filling his head. From the recognition of the vital importance of science to its establishment by the State—in a much less half-hearted fashion than at present—is in these days a short and inevitable step. The same considerations by which State interference has been justified elsewhere—its greater certainty, its ampler resources, its wider range—are all equally applicable here, and will come to be equally applied."

The *Globe* says the "argument" of the address may be conceded. Science deserves from the State all that the State can do for her. Minerva is a sort of alien deity in our intellectual Pantheon, and it is certain that the tendency and pressure of modern conditions impose upon all civilised States, an increasing obligation to learn or to lag. But it questions whether we really are in the evil plight depicted by the President, and points to "the magnificent private endowments of our insular foundations"—a source of revenue comparatively non-existent abroad, which, it states, Sir Lyon Playfair strangely ignores.

The *St. James's Gazette* thinks that reformers might bend some of their energies to seeing that more technical science and more arts likely to be useful to the craftsman and the mechanic, were brought within the curriculum of the Board Schools. For them we could easily spare some of the literary subjects:—

"With the moral of Sir Lyon Playfair's scientific sermon, and the journalistic lectures based on it, most people will agree. This is an age of science, and you can do nothing effectual in the practical way, from building ironclads to catching mussels, without a knowledge of what are called 'the laws of nature.' If you do not want your ironclads to be sunk by those of other navies, or your mussel trade to be ruined by foreign competition, you will do well to see that the 'laws of nature' are properly studied in your schools and colleges. That technical education in this country is not so good as it might be, and as it possibly is elsewhere, may be admitted."

But it does not think that this is due to superabundance of classics in our system of middle and higher-class education.

The *Guardian*, at the conclusion of a lengthy article devoted to the address, sums up its conclusions on the subject of the relations of the State to science thus:—

"On the whole we are inclined to think that the best service the State can render to education is to continue to help it in the unsystematic and irregular way which has hitherto proved so useful, considering each case as it arises, and adapting its measures to the particular needs which are brought before it. Much more may, no doubt, be done for Science, but it may be done in the same way as before, by grants for special purposes, by expeditions fitted out for costly investigations, perhaps by the foundation of professorships and scholarships. But it would be a misfortune if the free action of individual thought were repressed by being obliged to conform to the rules of a State imposed system, or if individual exertion and private munificence were discouraged by the habit, already growing upon us too much, of looking to the State rather than to ourselves for the removal of every difficulty and the promotion of every useful end."

The *Athenæum*, refers to what has been done by the State for science since the last meeting of the British Association at Aberdeen twenty years ago, and instances the Science and Art Department, the Natural History Museum, grants to the Royal Society, &c., proceeds:—

"All this—and much more might be added—shows that British statecraft is not altogether disposed to frown coldly upon science and its devotees. And yet, after all, how little—how miserably little—has been officially done for the promotion of science compared with the magnitude of our scientific interests and the wealth of our country! It is only by looking abroad and observing what has been accomplished in other lands that we realise our own shortcomings. Germany and France, Switzerland, and some of the other small continental States, have displayed a zeal for scientific progress and a liberal recognition of science which strikingly contrast with our own parsimony. Even when we have undertaken a good work our heart has often failed us in carrying it through with dignity and liberality. As a striking and recent example we may refer to the *Challenger* expedition. Here was an expedition splendidly equipped for scientific work at the expense of the nation; and yet, when the results of the expedition come to be published as voluminous reports, they are distributed with so sparing a hand, and are published at so high a price, as to be practically inaccessible to most men of science."

The *Saturday Review* says that Sir Lyon Playfair's words are tempered by the consciousness that he may some day be called upon to make them good, and this adds the greater force to the adverse verdict which he is compelled to give, the censure which he cannot help pronouncing on the action of the State towards science in England. The reply to the question, What has the State done directly for science? the answer is, But little compared with the need, and that little often in the wrong way. As the pocket is said to be the most sensitive part of our race, it is to be hoped that when the British Association next meets in Aberdeen its future president will not be forced to repeat Sir Lyon Playfair's assertion "English Governments alone fail to grasp the fact that the competition of the world has become a competition in intellect."

The *Spectator* speaks of the address as like a sermon preached by a popular clergyman on behalf of science, and wants to know why this branch of thought needs help so much more than art, literature, or pursuits like archæology, or the study of the historic past. It doubts whether in science, as in an army, honourable poverty does not conduce to the highest efforts; and whether richly endowed schools will produce the most successful professors, even in the inferior domain of applied science. Wheatstone was great, and was paid? but how much a year, it asks, did Friar Bacon get? or did any body ever pay that early expert in natural science who discovered fire?

"And remembering what the history of thought has been, we cannot but deprecate that spirit of sordidness in which for some years past the claims of science have been pressed—the desire for salaries which has been so conspicuous whenever professors have descanted on the merits of research. We have not the slightest objection to scientific departments, and quite agree with Sir Lyon Playfair that if the State wants fishes it could learn how to get them better by inquiring of the fishes—who, at least, tell no lies—than of the fishermen, who often do; but still the picture he draws of the United States Government, with its dozen departments of inquiry into geology, palæontology, ichthyology, chemistry, and the rest, does not inspire us with enthusiasm. It is all very excellent, no doubt; but it was all consistent with slavery. France may be handed over to Paul Berts and its judges still take bribes."

The *Glasgow Herald* pronounces Sir Lyon Playfair's address a signal success. Those pedantic persons who fail to see the uses of science might find in the address an admirable lesson against the perpetual sneering at what they are pleased to term the abstractions of scientific teaching. Sir Lyon, in a word, has emphasised the teaching that the safety and the progress of every country are one with scientific advance and the growth of scientific precision.

On the whole, then, it may be pronounced that the movement in favour of State aid to science, in the interest of the State itself rather than of any particular branch of human knowledge, has advanced and has taken a hold of the public mind. The need is universally acknowledged; in many quarters it is proposed to meet it by the application of endowments, ancient and modern, to the changed requirements of the present day; in others—and these amongst the influential—it is boldly declared that the State must link itself, at whatever cost, with science if this country is to hold its high place amongst nations "The same considerations by which State interference has been justified elsewhere—its greater certainty, its ampler resources, its wider range—are all equally applicable here, and will come to be equally applied."

## 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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### The New Star in Andromeda

On seeing the report in yesterday's *Standard* of the remarkable change in the nucleus of the nebula of Andromeda, I decided to write to you to mention that, accidentally noticing the nebula on Sunday evening, the 6th, I was struck by its conspicuousness, and set wondering how the ancients came to overlook an object so prominent. As frequent watching for meteors has made that region very familiar to me, it seems likely that an increase in general brightness has occurred, and made me specially notice its appearance.

What is of far more interest, however, I have learnt this morning that one of our scholars, Lawrence Richardson, noted and *recorded* an apparent change in the nebula, as he saw it in our 4½ inch Cooke's refractor, about 9 p.m. September 1. I append a *verbatim* copy from his diary of what is perhaps the first English observation of this remarkable phenomenon.

J. Edmund Clark

Friends' School, Bootham, York, September 9

(Copy) "Sept. 1 . . . As a beginning [of the season's work] looked at Polaris, ε Lyræ and the great nebula of Andromeda. Noticed a small star in the centre of the latter which I do not remember having seen before, and which is not down in a small drawing I made on September 15, 1884.

### Norwegian Testimony to the Aurora-Sound

How widespread in our days is the belief in the sound of the Aurora in Norway, the following may show. In March, 1885, I despatched some thousand circulars to all parts of the country containing different queries regarding the aurora, and amongst these also the following:—Have you or your acquaintances ever heard any sound during aurora, and, in this case, when and in what manner? Up to this date I have received answers to these queries from 144 persons in different parts of the country. Of these there are not less than 92, or 64 per cent., who believe in the existence of the aurora-sound, and 53 (36 per cent.) of these again state they have heard it themselves, whilst the other 39 cite testimonials from other people; only 21 (15 per cent.) declare they never have heard the sound or know anything about it, and the other 31 (22 per cent.) have not noticed the query at all. There are thus 92 affirmations against 21 negations.

The sound is described in these answers in the following manner:—

Sizzling (3)
Creaking or sizzling
An intermediate sound between sizzling and whizzing, sometimes as if a piece of paper were torn
A kind of sound as when you tear silk
Sizzling, th—ss
Soft whizzing, alternative with sizzling
Soft crackling, sizzling
Hissing and crackling
Partly hissing, partly as a kind of rushing whiz
Whispering and glistering
Strong whiz (3)
Whiz or whispering
Whiz, or distant, soft, continuous whizzing
A rather heavy rush, as from a distant waterfall
Quiet whizzing, hissing
Hissing, or hoy! hoy! hoy!
Whiz (2)
Rush, as from a stream
Soft but distant crackling, as from a lighted match-cord
Whizzing (5)
Whizzing in the air
Rush, as when sheep are chased
Soft whiz or hissing
Soft whiz
Soft hissing, soft whiz
Whizzing or whistling
Rippling
Crackling (4)
Hissing
Hissing noise in the air
Crack in the air
Din in the air
Continuous sounding, rolling din in the air
Clashing
Flapping, as a flag before the wind
Partly as rustling or flapping of sails hanging loose fore the wind, partly as hissing from fire
Like the noise from a distant, before the wind-flapping flag, which now and then sends out a creaking sound
Like the sound from sails of a ship hanging loose in stormy weather
Monotonous whizzing and creaking, as when a sheet flaps before the wind
Like burning juniper-boughs
Brustling or crackling as if burning juniper
As from a feeble burning flame
Like burning dried juniper
As from the flames of a conflagration
Cutting, hissing as from flames
Crackling and creaking, a noise as from a large fire-flame—as, for instance, burning dried boughs
Like the sound from a flight of birds
Noise as when a bird flaps in the air
Strong flapping noise, as when a bird passes very near you
Crackling from fire and flapping from wings
As of a bird flying through the air with great velocity
Whizzing noise, as when striking the air with a whip
Noise as from the dart of an arrow
Like the buzzing of a bee
Roaring noise, as when strong gushes of wind dart through the tree-tops of the wood
Creaking sound as from the blowing of the wind
Distant roar, as from a storm
Roaring as from a storm
Roaring as from a whirlwind
As from a soft-blowing wind
Soft breeze
Like the soft breeze through a wood
Whipping with whisk-brooms
Fanning
Soft noise, as when fanning with a piece of paper from a distance
Soft flapping with a piece of cloth
Roaring of the sea
Heavy, hollow roar from the sea
Sweeping sound, as when dry snow is sweeping over an ice-field
As when one holds a cloth by two corners and flaps with it

| | |
|---|---|
| Creaking, at other times, as when a sail strikes against the mast or flaps before the wind | As when a thunder-clap passed over us from west to east |
| Partly whizzing, partly as when a sail flaps before the wind | Soft crackling, as from electric sparks from an electrical machine |
| As when a sail flaps before the wind | As when stroking a cat's back against the hairs |

Christiania, September 16 SOPHUS TROMHOLT

### A White Swallow

DURING our walk to-day on the Kendal Road, near Heversham, my brother and I were very much surprised to see a white swallow amongst a number of the ordinary kind. The bird's plumage was entirely white, except the lower part of the breast, which was greyish.

We are quite sure of its identity, as it flew around us several times.

Can you tell us whether a white swallow is really an uncommon sight? MARY BRIGGS

Sandside, near Milnethorpe, Westmoreland, September 4

## THE HUME COLLECTION OF ASIATIC BIRDS

FOR some time past the interest of ornithologists has been aroused by the rumour that Mr. A. O. Hume, of Simla, had offered, or intended to give, his celebrated collection of Asiatic Birds to the Trustees of the British Museum; and I am glad to be able to inform the readers of NATURE that the whole of this collection is now safely housed in the Natural History Museum, the second half having been delivered by the P. and O. Company on the 18th of last month.

Those of our readers who are not ornithologists may wish to learn something in the first place about the collection itself and its generous donor.

Mr. A. O. Hume, C.B., occupied formerly a high position in the Bengal Civil Service, and devoted for many years his leisure hours to the study of ornithology, and especially of the birds of India. His aim was to form a collection of birds of every part of the British Asian Empire, in which every species should be represented by a complete series of specimens illustrating its range and its variations of colour according to age, season, or locality. For this purpose he organised a system under which a great number of local observers and collectors (in some years numbering nearly 100) worked for and with him. He fitted out expeditions with a staff of collectors and taxidermists, under his own leadership or that of his able former curator, Mr. Davison, into Scinde, Coorg, Manipur, the Malayan Peninsula, Tennasserim, and the Andaman and Nicobar Islands; he acquired by purchase or donation the Mandelli collection from Sikkim and Tibet, Brook's beautiful series from North-Western and Central India, Adam's Sambhur birds, Bingham's collections from Delhi and Tennasserim, Scully's collection from Turkestan. The expense incurred in forming this collection was in proportion to the enthusiasm with which Mr. Hume worked. He had built at Simla a museum for the reception of the collection which should finally form the basis for the preparation of a comprehensive work on the avifauna of the vast region which he was exploring. But whilst thus engaged Mr. Hume, with his wonderful activity and ready pen, which had rendered him *facile princeps* in all matters regarding Indian ornithology, published numerous papers in an ornithological periodical, *Stray Feathers*, which he founded and conducted for ten or eleven years, as well as several separate works—viz. "Notes on the Indian Raptores," "Nests and Eggs of Indian Birds," "List of the Birds of India," "Game Birds of India, Burmah, and Ceylon," and others.

However, during the last few years naturalists, to their great regret, became aware that Mr. Hume's interest in social and political nature; and finally, the grievous loss by theft of an enormous mass of ornithological manuscripts, comprising his materials for "The Birds of the British Asian Empire," and the whole of his Museum Catalogue, contributed to his determination to abandon his intention of working out his collection, and to present it to some museum where others might utilise the materials he had collected.

It is very gratifying that Mr. Hume, "considering the British Museum as the one that has most claims upon him, and Mr. Sharpe as the man most capable in Europe of doing justice to the collection," offered to present it to the Trustees of that institution. The Trustees, fully aware of the scientific importance of the collection, had no hesitation in accepting the offer. Still, before actually transferring the collection, Mr. Hume was desirous of completely rearranging and placing it in thorough good order, and also of preparing at the same time a Catalogue of the Birds of the Indian Empire containing the results of his long and careful studies. Unfortunately this project could not be carried out owing to the difficulty of finding a competent coadjutor in the work, or rather of obtaining the means of properly remunerating such a person. And as there was great risk in leaving the collection without due curatorial supervision exposed to the deteriorating influences of another rainy season in India, the Trustees obtained Mr. Hume's consent to transmitting the collection without further delay to England.

Mr. Sharpe, who is always ready to sacrifice his personal comfort to duty, started for Simla almost at a moment's notice, and although, unseasoned as he was, he had to travel and work during the hottest part of the year, he seems to h[illegible]sed his energy in[illegible] all who had to help him in [illegible] task of pack[illegible] tion. He started [illegible]ived in S[illegible] completed his wor[illegible]f June, [illegible] the Museum on A[illegible] the sa[illegible] on his return the [illegible]ction w[illegible] ceded him safely lo[illegible]eum, w[illegible] half was delivered a[illegible]out loss [illegible] to, any of [illegible]

The c[illegible] skins o[illegible] 63,000 s[illegible],500 eg[illegible] packed [illegible]y with [illegible] of 30 c[illegible] are [illegible] inspecti[illegible] convey a[illegible] the Nati[illegible] such a co[illegible] will proba[illegible] enveloped [illegible] the species [illegible] labels being, [illegible] skins themsel[illegible] to the precau[illegible] likely to har[illegible] Specimens whic[illegible] to which no speci[illegible] during packing.

The scientific va[illegible] to be measured by [illegible] the judgment which [illegible] history attached to m[illegible] ness of the series. [illegible] contains about 2000 sp[illegible] species is represented [illegible] number in the majority [illegible] a fair illustration of its r[illegible] the number of duplicate[illegible] Mr. Sharpe during the pro[illegible] probably be much smaller t[illegible] superficial inspection; and I [illegible] earnest wish [illegible] intact, will be strictly carried out. No doubt a considerable number of duplicates will be eliminated, and, according to the wish of the donor, of these a complete set has to be transmitted to the Museum of Comparative Zoology of Harvard College, whilst the remainder are to be utilised for the benefit of the ornithological collection generally.

Ornithologists need not go many years back in recalling to their memory the extent of the collection which the late Mr. G. R. Gray had arranged in such a handy fashion in and about his study in the old building at Bloomsbury. What was then regarded a good reference collection has since been enriched by the addition of the Wallace collection from the Indian Archipelago, Capt. Pinwill's Malayan birds, Sharpe's African collection, the Gould collection, Salvin and Godman's European, Australian, and American collections, the Sclater collection, and now by this immense collection from every part of the Indian Empire. Years of unremitting labour will be required to get these vast materials into order and to work them out in a manner which will satisfy the aims of so advanced a branch of science as ornithology is at the present day.

ALBERT GÜNTHER

## *THE FORSTER HERBARIUM*

BOTANISTS will learn with pleasure that this herbarium, a portion of the collections of Cook's second voyage, has been acquired by exchange from the Liverpool Corporation for the Kew Herbarium; and it will be incorporated in the general collection. From the introduction to the "Catalogue of Plants" in the Botanic Gardens at Liverpool, published in 1808, it appears that the proprietors of that establishment possessed, at that date, about 3000 specimens of dried plants, "collected by the late Dr. Forster in his voyages to the South Seas, with large and valuable contributions from his friends and correspondents." How these plants came into their possession is uncertain, but they could hardly have been presented to them by Mr. Shepherd, the Curator, as stated by Sir Joseph Hooker in the introductory essay to his "Flora Novæ-Zealandiæ," or his name would almost [illegible]tainly have been mentioned as the donor. At least [illegible] may be inferred, because on the very next page a [illegible]igh tribute is paid to Mr. John Shepherd for his [illegible] to the Garden. Be that as it may, the collection [illegible]ly be accessible to botanists generally, thanks [illegible]verance of Sir Joseph Hooker and the sensible [illegible] matter taken by the present members of the [illegible] when it was represented to them that these [illegible]re practically useless where they were, [illegible]able at a botanical establishment like [illegible] the Corporation deserves to be re- [illegible] thirty years ago, when Sir Joseph [illegible] writing his "Flora Novæ-Zea- [illegible] then custodians of the collec- [illegible] to Kew for comparison [illegible] refused.

[illegible]n with the *Chall-* [illegible] existence of [illegible] was deter- [illegible]blivion, [illegible]cting [illegible]nd [illegible]r-

an assistant. On arriving at the Cape of Good Hope they fell in with Sparmann, who, at the instance and expense of Forster, was added to the scientific staff, and continued with them until the return to the Cape in 1775. Considerable collections of plants were made in New Zealand, many parts of Polynesia, and the extreme south of America, and smaller collections in some of the Atlantic Islands, including St. Helena, Cape Verd Islands, and Canaries. On returning to England the Forsters soon commenced publishing the botanical results of the expedition, and an authenticated set of all the published plants at least was deposited in the British Museum. The Cape plants, however, which they did not publish, are apparently not represented there. The first botanical work, "Characteres Genera Plantarum," appeared in 1776, and the title-page bears the names of both father and son, and this was the only one published in England. For the rest, the botany was done by the son alone. His "Florula Insularum Australium Prodromus" appeared at Göttingen in 1786, and "De Plantis Esculentis Insularum Oceani Australis" at Berlin in the same year, followed by "De Plantis Magellanicis et Alanticis" at Göttingen in 1787.

These works, we believe, constitute the whole of the published botany of the expedition, and, though very meagre, are extremely interesting, being the foundation of our knowledge of New Zealand, Antarctic, and Polynesian vegetation. The collection now acquired for Kew is excellently preserved, and the plants mostly named and localised. It comprises altogether 1359 species, 785 of which were collected on the voyage with Cook, and the rest, from various parts of the world, are probably some of those alluded to above as having been presented to Forster by his friends. The collection includes a large proportion of the plants published by the Forsters, but it is not complete. Roughly, there are 187 species from Polynesia, 119 from New Zealand, 21 from the extreme south of America, 23 from the Atlantic Islands, including all those described by Forster from St. Helena, and 9 from Australia. Besides the foregoing, which are all phanerogams, there are 36 ferns, but they include only a small portion of the species described by Forster.

In addition to this botanical work George Forster's name appears on the second title-page of the Narrative of the second voyage as joint author with James Cook. He died, a violent death, we believe, at Paris in 1794, four years before the decease of his father. The philosophical writings of the latter, entitled "Observations made during a Voyage round the World," London, 1778, deserve special mention

W. BOTTING HEMSLEY

## *THE INTERNATIONAL METEOROLOGICAL COMMITTEE*

THIS Committee held its third meeting in Paris at the Ministry of Public Instruction on September 1 to 8. The Meeting was attended by the President, Prof. Wild (Russia); the Secretary, Mr. R. H. Scott; Profs. Buys Ballot (Holland), Hann (Austria), Mascart (France), Mohn (Norway), Dr. Neumayer (Germany), and Prof. Tacchini (Italy). M. de Pinto Capello (Portugal), the only remaining member, was unfortunately unable to be present.

In addition certain gentlemen were present by invitations at some of the meetings, among these we may mention Brigadier-General Hazen (Chief Signal Officer, U.S.A.), Prof. Hildebrandsson (Upsala), and M. Leon Teisserenc de Bort.

The following is a brief notice of the most important [illegible] discussed, with the action taken on each.

[illegible]able report on cirrus observations by the Com- [illegible] appointed at Copenhagen (1882), MM. Capello, [illegible]n, and Ley, was submitted, and will be [illegible]

[illegible] Atlantic telegrams was discussed with [illegible] was decided to maintain the present system of reports from ships' logs which has been carried on since Christmas by the Meteorological Offices of France and this country, and to endeavour to improve it.

At the same time a proposal made by M. L. Teisserenc de Bort for the telegraphic transmission of a daily *résumé* of the weather in the New England States was considered. General Hazen expressed perfect readiness to furnish such reports, and it was resolved to procure such telegrams provided the cost of the service could be guaranteed by the European offices which would participate in it.

It was decided to recommend that barometrical observations should be corrected for the force of gravity at lat. 45°.

A letter from General Hazen respecting the reduction of barometer readings to sea-level, which has been lately circulated, was considered, and two memoranda on the subject from Hamburg and St. Petersburg respectively were handed in and will be printed.

It was considered *desirable*, as absolute synchronism in weather observations appears to be unattainable in Europe, that the same hours of local time should be adopted in each country (which would mean a change from 8 a.m. to 7 a.m. in this country).

It was decided that each of the International Reduction Tables (proposed by the Committee at its meeting at Berne in 1880) as did not involve any question which is still in an undecided state (such as, *e.g.*, hygrometrical tables, or tables of sea-level reduction) should be published.

It was decided to recommend that the next Congress should not take place till 1889, and Prof. Mascart stated that probably the French Government would propose that it should be held in Paris.

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## *THE BRITISH ASSOCIATION*

JUDGED by the quantity of work which the sections have put through their hands the Aberdeen meeting has been successful almost beyond precedent. Moreover much of this work has been of the best quality. The addresses come up to a very high standard, and in the first four sections, at least, not a few of the papers were really important original contributions to science, while the discussions in Sections A and B on certain great questions in physics and chemistry were a marked and commendable feature—a feature which, it is hoped, will in time become common to all the sections. Mr. Murray's lecture on deep-sea research has been justly considered one of the leading events of the meeting; a full report will appear in our columns.

At the concluding general meeting a deservedly hearty vote of thanks was accorded to the Aberdonians for their abundant hospitality. Birmingham seems determined to make next year's meeting a memorable one; and we may remind our readers that Sir William Dawson, of McGill College, Montreal, will be the President.

The total number of persons who attended the Aberdeen meeting was 2203.

The following is a synopsis of grants of money appropriated to scientific purposes by the General Committee at the Aberdeen meeting. The names of the members who would be entitled to call on the General Treasurer for the respective grants are prefixed:—

A—*Mathematics and Phy*[illegible]

| | |
|---|---|
| *Foster, Prof. G. Carey—Electrical Standards [illegible] | £[illegible] |
| *Stewart, Prof. Balfour—Solar Radiation [illegible] | [illegible] |
| *Stewart, Prof. Balfour—Meteorological [illegible] Chepstow | [illegible] |
| Darwin, Prof. G. H.—Instructions for [illegible] tions ... | [illegible] |
| *Stewart, Prof. Balfour—Comparing and [illegible] netic Observations | [illegible] |
| *Forbes, Prof. G.—Standards of Light [illegible] | [illegible] |
| *Brown, Prof. Crum—Ben Nevis Observat[illegible] | [illegible] |
| *Armstrong, Prof.—Physical and Chemical [illegible] Electrolysis ... | [illegible] |

B—*Chemistry*

| | |
|---|---|
| M'Leod, Prof.—Silent Discharge of Electricity into Atmosphere ... ... ... ... ... ... | £20 |
| *Williamson, Prof. A. W.—Chemical Nomenclature ... | 5 |

C—*Geology*

| | |
|---|---|
| *Blanford, Mr. W. T.—Fossil Plants of the Tertiary and Secondary Bed ... ... ... ... ... | 20 |
| Hughes, Prof. T. McK.—Caves of North Wales ... | 25 |
| *Etheridge, Mr. R.—Volcano Phenomena in Japan ... | 50 |
| *Grantham, Mr. R. B.—Erosion of Sea Coasts ... ... | 20 |
| *Bannerman, Mr. H.—Volcanic Phenomena of Vesuvius | 30 |
| *Evans, Dr. J.—Geological Record ... ... ... | 100 |
| *Etheridge, Mr. R.—Fossil Phyllopoda ... ... ... | 15 |

D—*Biology*

| | |
|---|---|
| *Stanton, Mr. H. T.—Zoological Record ... ... | 100 |
| *Murray, Mr. J.—Marine Biological Station at Granton.. | 75 |
| *Lankester—Prof. Ray—Zoological Station at Naples ... | 50 |
| Cleland, Prof.—Researches in Food Fishes at St. Andrew's ... ... ... ... ... ... | 75 |
| *Cordeaux, Mr. J.—Migration of Birds ... ... ... | 30 |
| Cleland, Prof.—Mechanism of Secretion of Urine ... | 10 |

E—*Geography*

| | |
|---|---|
| Walker, General J. T.—New Guinea Exploration ... | 150 |
| Walker, General J. T.—Investigation into Depth of Permanently Frozen Soil in Polar Regions ... ... | 5 |

F—*Economic Science and Statistics*

| | |
|---|---|
| Sidgwick, Prof.—Regulation of Wages under Sliding Scales ... ... ... ... ... ... ... | 10 |

G—*Mechanics*

| | |
|---|---|
| Barlow, Mr. W. H.—Effect of Varying Stresses on Metals ... ... ... ... ... ... ... | 10 |

H—*Anthropology*

| | |
|---|---|
| Garson, Dr.—Investigation into a Prehistoric Race in the Greek Islands ... ... ... ... ... | 20 |
| *Tylor, Dr. E. B.—Investigation into North-Western Tribes of Canada ... ... ... ... ... | 50 |
| *Galton, Mr. F.—Racial Characteristics in British Isles.. | 10 |
| | £11[illegible] |

* Reappointed.

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### REPORTS

*Report of the Committee, consisting of Mr. Robert H. S*[illegible] *(Secretary), Mr. J. Norman Lockyer, Prof. G. G. Stokes, Pro*[illegible] *Balfour Stewart, and Mr. G. J. Symons, appointed for* [illegible] *purpose of co-operating with the Meteorological Society of th*[illegible] *Mauritius in their proposed publication of Daily Synopti*[illegible] *Charts of the Indian Ocean from the year* 1861. *Drawn up by Mr. R. H. Scott.*—The Committee forward, for the inspect[illegible] of the members of the Association, a copy of the charts for the month of March, 1861, with some specimens for January of the same year, and the complete number for February which appeared some years ago. These documents have recently arrived from the Mauritius. As the work has now made decided progress the Committee have applied for and obtain[illegible] the grant of 50*l*. placed at their disposal by the General Com[illegible]mittee. As soon as the requisite documents are received [illegible] Dr. Meldrum the Committee will submit a formal account [illegible] their expenditure with the necessary vouchers.

[illegible] *Report of the Committee, consisting of Prof. Sch*[illegible] [illegible] *Prof. Balfour Stewart, Prof. Stokes, Mr. G. Joh*[illegible] [illegible] *Prof. Sir H. E. Roscoe, Capt. Abney, and Mr.* [illegible] [illegible] *the purpose of considering the* [illegible] *the Best Methods of Solar Radiation*— [illegible] comparisons of the instrument proposed by the Committee with an ordinary actinometer, to find whether the arrangement suggested by the Committee is likely to succeed in practice. The Committee would therefore confine their action for the present to the carrying out of such a series of comparisons. (3) The size of the instrument might be the same as that of Prof. Stewart's actinometer. (4) The instrument should have a thick metallic enclosure, as in the actinometer above-mentioned, and in this enclosure there should be inserted a thermometer to record its temperature. Great pains should therefore be taken to construct this enclosure so that its temperature shall be the same throughout. (5) The interior thermometer should be so constructed as to be readily susceptible of solar influences. It is proposed to make it of green glass (a good absorber), and to give it a flattened surface in the direction perpendicular to the light from the hole. (6) It seems desirable to concentrate the sun's light by means of a lens upon the interior thermometer, as in the ordinary instrument. For if there were no lens the hole would require to be large, and it would be more difficult to prevent the heat from the sky around the sun from interfering with the determination. Again, with a lens there would be great facility in adjusting the amount of heat to be received by employing a set of diaphragms. There are thus considerable advantages in a lens, and there does not appear to be any objection to its use.

*Third Report of the Committee, consisting of Profs. G. H. Darwin and J. C. Adams, for the Harmonic Analysis of Tidal Observations. Drawn up by Prof. G. H. Darwin.*—"Record of Work during the past Year." The edition of the computation forms referred to in the second report is now completed, and copies are on sale with the Cambridge Scientific Instrument Company, St. Tibbs' Row, Cambridge, at the price of 2*s.* 6*d.* each. Some copies of the first report, in which the theory and use of these forms are explained, are also on sale at the same price. A few copies of the computation forms have been sent to the librarians of some of the principal scientific academies of Europe and America. In South Africa, Mr. Gill, at the Cape, and Mr. Neison, at Natal, are now engaged in reducing observations with forms supplied from this edition. A memorial has been addressed to the Government of the Dominion of Canada, urging the desirability of systematic tidal observation, and the publication of tide-tables for the Canadian coasts. There seems to be good hope that a number of tide-gauges will shortly be set up on the Atlantic and Pacific coasts, and in the Gulf of the St. Lawrence. The observations will probably be reduced according to the methods of the British Association, and the predictions made with the instrument of the Indian Government. Major Baird has completed the reduction of all the tidal results obtained at the Indian stations to the standard forms proposed in the Report of 1883, and Mr. Roberts has similarly reduced a few results read before the Association by Sir William Thomson and Capt. Evans in 1878. All these are now being published in the *Proceedings* of the Royal Society, in a paper by Major Baird and myself. A large number of tidal results have been obtained by the United States Coast Survey, and reduced under the superintendence of Prof. Ferrel. Although the method pursued by him has been slightly different from that of the British Association, it appears that the American results should be comparable with those at the Indian and European ports. Prof. Ferrel has given an assurance that this is the case; nevertheless, there appears to be strong internal evidence that, at some of the ports, some of the phases should be altered by 180°. The doubt thus raised will probably be removed, and the paper before the Royal Society will afford a table of reference for all —or nearly all—the results of the harmonic method up to the date of its publication. The manual of the tidal observation promised by Major Baird is now completed, and will be published shortly. This work will explain fully all the practical difficulties likely to be encountered in the choice of a station for a tide-gauge, and in the erection and working of the instrument. Major Baird's great experience in India, and the success with which the operations of which he has had charge have been carried out, render his advice of great value for the prosecution of tidal observation in other countries. The work also explains the method of measuring the tide diagrams, entering the figures in the computation forms, and the subsequent numerical opera- [illegible]

[illegible] *of the Committee, consisting of Prof. Balfour* [illegible] *Knox Laughton, Mr. G. J. Symons, Mr. R. H. Scott, and Mr. Johnstone Stoney, appointed for the purpose of cooperating with Mr. E. J. Lowe in his project of establishing a Meteorological Observatory near Chepstow on a permanent and scientific basis.*—Since their re-appointment in 1885 this Committee have met twice, and have placed themselves in correspondence with Mr. Lowe, to whom the following letter was written by their Secretary: "The Committee request me to point out to you that the main feature of your proposal, which interests the British Association and the scientific public generally, is the prospect which it holds out of the establishment of a *permanent* institution, by means of which meteorological constants could be determined, and any secular change which may take place therein in the course of a long period of years be ascertained. It will be for you and the local authorities to decide what amount of work of *local interest* should be contemplated, and on this will the scale of the observatory mainly depend. The Committee are therefore unable to say what amount of capital would be required. They would point out four conditions which they hold to be indispensable:—(1) The area of ground appropriated should be sufficient to ensure freedom from the effects of subsequent building in the neighbourhood. (2) A sufficient endowment fund of at least 150*l.* annually should be created. (3) The control should be in the hands of a body which is in itself permanent as far as can be foreseen. (4) The land for the site shall be handed over absolutely to the above-mentioned governing body. Until the precise amount of the local meteorological requirements is ascertained and further progress is made in the scheme the Committee consider that they would not be justified in any more prominent action than that which they have already taken.

*Report of the Committee, consisting of Profs. A. Johnson (Secretary), J. G. MacGregor, J. B. Cherriman, H. T. Bovey, and Mr. C. Carpmael, appointed for the purpose of promoting Tidal Observations in Canada.*—The Committee, in order to strengthen their representation to the Canadian Government on the necessity of establishing stations for continuous tidal observations, deemed it well to get the opinions of Boards of Trade and ship-owners and ship-masters. On inquiry it appeared that the Montreal Board of Trade were at the very time considering the question, which had been brought independently before them. On learning the object of the Committee they gave it their most hearty support, and addressed a strong memorial on the subject to the Dominion Government. The Boards of Trade of the other chief ports of the Dominion also sent similar memorials. The ship-owners and masters of ships, to whom application was made, were practically unanimous in their testimony as to the pressing need for knowledge on the subject. The representations were made through the Minister of Marine, with whom an interview was obtained, at which a memorial was submitted. Copies of the answers of the ship-masters (a large number of which had been received) were submitted at the same time. The reply of the Minister of Marine stated that, owing to the large outlay on the Georgian Bay Survey and on the expedition to Hudson's Bay during the past summer (1885), the Government did not propose to take action in the matter of tidal observations at present. The Committee have reason to believe that if the financial prospects improve by next session of Parliament the Government will take the matter into earnest consideration; they therefore suggest that the Committee be reappointed.

*Seventeenth Report of the Committee, consisting of Profs. Everett and Sir W. Thomson, Mr. G. J. Symons, Sir A. C. Ramsay, Dr. A. Geikie, Mr. J. Glaisher, Mr. Pengelly, Prof. Edward Hull, Prof. Prestwich, Dr. C. Le Neve Foster, Prof. A. S. Herschel, Prof. G. A. Lebour, Mr. Galloway, Mr. Joseph Dickinson, Mr. G. F. Deacon, Mr. E. Wethered, and Mr. A. Strahan, appointed for the purpose of investigating the Rate of Increase of Underground Temperature downwards in various Localities of Dry Land and under Water. Drawn up by Prof. Everett (Secretary).*—The present Report is for the two years since the summer of 1883. Observations have been taken in a deep bore at Richmond, Surrey, by Mr. Collett Homersham, C.E., the engineer of the boring, on the premises of the Richmond Vestry Waterworks, on the right bank of the Thames, and about 33 yards from high-water mark. The surface is 17 feet above Ordnance datum. The upper part consists of a well 253 feet deep, with an internal diameter of 7 feet at top and 5 feet at bottom, which was sunk in 1876 for the purpose of supplying water to the town of Richmond, and carried down to the chalk. From the bottom of the well a 24-inch bore-hole was sunk to the total depth of 434 feet, thus penetrating 181 feet into the chalk. This portion of the work was completed in 1877. Above the chalk were tertiaries, consisting of 160 feet of London clay, 60 feet of the Woolwich and Reading beds, and some underlying sands. The water yielded at this stage was about 160 gallons a minute, and, when not depressed by pumping, was able to rise 4 or 5 feet above the surface. Its ordinary level, owing to pumping, was about 130 feet lower. In 1881 the Richmond Vestry determined to carry the bore-hole to a much greater depth, and the deepening has been executed under the direction of Mr. Homersham. The existing bore-hole was first enlarged and straightened, to enable a line of cast-iron pipes, with an internal diameter of 16½ inches, having the lower end driven water-tight into the chalk at a depth of 438 feet, to be carried up to the surface. The total thickness of the chalk was 671 feet. Below this was the upper greensand, 16 feet thick; then the gault clay, 201½ feet thick; then 10 feet of a sandy rock, and a thin layer of phosphatic nodules. Down to this point the new boring had yielded no water. Then followed a bed 87½ feet thick, consisting mainly of hard oolitic limestone. Two small springs of water were met with in this bed at the depths of 1203 and 1210 feet, the yield at the surface being 1¼ gallons a minute, with power to rise in a tube and overflow 49 feet above the ground. A partial analysis of this limestone rock showed it to contain 2·4 per cent. of sulphide of iron in the form of pyrites. At the depth of 1239 feet this limestone rock ended, and hard red sandstone was found, alternating with beds of variegated sandy marl or clay. After the depth of 1253 feet had been attained, the yield of water steadily increased as the boring was deepened, the overflow at the surface being 2 gallons a minute at 1254 feet, 8 gallons at 1363 feet, and 11 gallons at 1387 feet. It rose to the top of a tube carried 49 feet above the surface, and overflowed; and a pressure-gauge showed that it had power to rise 126 feet above the surface. The diameter of the bore was 16½ inches in the chalk, 13½ inches in the gault, 11¼ inches in the oolitic limestone, and at the depth of 1334 feet it was reduced to a little under 9 inches. At 1337 feet the method of boring was changed, and, instead of an annular arrangement of steel cutters, a rotary diamond rock-boring machine was employed. The bore-hole, with a diameter of 8½ inches, was thus carried down to 1367½ feet, at which depth, lining tubes having to be inserted, the diameter was reduced to 7¼ inches, and this size was continued to 1447 feet, at which depth the boring was stopped. The bore-hole was lined with strong iron tubes down to the depth of 1304 feet; and those portions of the tubes that are in proximity to the depths where water was struck were drilled with holes to admit the water into them. Three observations of temperature taken with an inverted Negretti maximum at the depth of 1337 feet, when the bore-hole was full of water, recorded 75½° F. In the first observation, March 25, 1884, the thermometer was left for an hour and a quarter at the bottom of the bore-hole, and three weeks had elapsed since the water was disturbed by boring. The second observation was taken on March 31, when the thermometer was 5½ hours at the bottom. In the third observation special precautions were taken to prevent convection. The thermometer was fixed inside a wrought-iron tube, 5 feet long, open at bottom. The thermometer was near the lower end of the tube, and was suspended from a water-tight wooden plug, tightly driven into the tube. There was a space of several inches between the plug and the thermometer, and this part of the tube was pierced with n[illegible] holes to allow the escape of any cold water which [illegible] carried down by the tube. The tube was one of [illegible] hollow boring-rods used in working the diamond dri[illegible] By means of these it was lowered very slowly, to av[illegible] ance of the water as much as possible; and the tube [illegible] the thermometer was gradually worked through the [illegible] bottom of the bore-hole. The lowering occupied fiv[illegible] and was completed at noon on Saturday, June 7. C[illegible] mixed with sugar, for the purpose of slow setting, was [illegible] diately lowered on to the surface of the sand, and above [illegible] mixture of cement and sand, making a total thi[illegible] of 3 [illegible] feet of cement plugging. The thermometer [illegible] for three full days, the operation of raising [illegible] noon of Tuesday, June 10, and comple[illegible] thermometer again registered 75½° F., exa[illegible] two previous observations which were tak[illegible] It would therefore appear that the steady u[illegible] lower part of the bore prevents any downward convection of colder water from above.

The boring has since been carried to the depth of 1447 feet, with a diameter reduced to 7¼ inches, and Mr. Homersham lowered the thermometer to the bottom without plugging. It remained down for six days (February 3 to 9, 1885), and gave a reading of 76¾° F. The water overflowing at the surface had a temperature of 59° F. To deduce the mean rate of increase downwards, we shall assume a surface temperature of 50°. This gives for the first 1337 feet an increase of 25½°, which is at the rate of 1° F. in 52·4 feet, and for the whole 1447 feet an increase of 26¾°, which is at the rate of 1° F. in 54·1 feet. These results agree well with the Kentish Town well, where Mr. Symons found in 1100 feet an average increase of 1° in 55 feet.

Mr. Galloway has furnished observations taken during the sinking of a shaft to the depth of 1272 feet in or near the Aberdare valley, Glamorganshire. The position of the shaft is on the slope on the east side of the valley, about midway between the bottom of the valley and the summit of the hill which separates it from the Merthyr valley. The mouth of the shaft is about 800 feet above sea-level. Observations were taken at four different depths—546 feet, 780 feet, 1020 feet, and 1272 feet—the thermometer being in each case inserted, and left for twenty-four hours, in a hole bored to the depth of 30 inches at a distance not exceeding 2½ yards from the bottom of the shaft for the time being. About eight hours elapsed between the completion of the hole and the insertion of the thermometer. The strata consist mainly of shales and sandstone, with a dip of 1 in 12, and the flow of water into the shaft was about 250 gallons per hour. The first of the four observations was taken in the fireclay under the Abergorkie vein; the second in strong "clift" (a local name for argillaceous shale) in disturbed ground; the third in bastard fireclay under a small rider of coal previously unknown; the fourth in "clift" ground two yards above the red ash vein, which overlies the 9-foot seam at a height of from 9 to 12 yards. The observations were as follow:—At 546 feet, 56° F.; 780 feet, 59½° F.; 1020 feet, 63° F.; 1272 feet, 66½° F. Comparing consecutive depths from 546 feet downwards, we have the following increments of temperature:—3½° in 234 feet, giving 1° for 67 feet; 3½° in 240 feet, giving 1° for 69 feet; 3½° in 252 feet, giving 1° for 72 feet; showing a remarkably regular rate of increase. A comparison of the first and fourth observations gives an increase of 10½° in 726 feet, which is at the rate of 1° F. in 69·1 feet. As a check upon this result we find that this rate of *decrease* reckoned *upwards* from the smallest depth (546 feet) would give a surface temperature of (56 − 7·9 =) 48°·1, which, as the elevation is 800 feet, is probably very near the truth.

Mr. Garside has sent an observation of temperature taken by himself in the roof of the Mersey tunnel in August, 1883. The temperature was 53°, the depth below Ordnance datum being 92 feet. A great quantity of water from the river was percolating through the sides of the tunnel. On August 13, 1884, he verified his previous observation in Denton Colliery (15th Report). The second observation was made at the same depth as the first (1317 fe[illegible] same pit and level, and under the same circumstances[illegible] that the thermometer was allowed to remain fourt[illegible] bored for it, instead of only six hours. The [illegible] was the sa[illegible] namely 66°. M[illegible] supplemen[illegible] contribution to o[illegible] surface [illegible] the ground in the Eas[illegible] more years' results [illegible] ence between them a[illegible] 1° for 300 feet, and [illegible] at small elevation[illegible] The [illegible] ester coal-field from [illegible] Pit (Dukinfield), A[illegible] are all sunk in g[illegible] It would th[illegible] *up by Mr. J. S. Gardner, F.G.S., F.L.S.*—The report opens with a list of all the principal works on the British Tertiary flora down to the year 188[illegible]. The number of species that had been more or less described were:—From the Thanet beds, 3; from the Reading beds, 9; from Sheppey, 108; from Alum Bay, &c., 43; from Bournemouth (deducting those not peculiar), 11; Bovey Tracy, 50; Upper Eocenes, 13; Mull, 9; Antrim, about 16; making a grand total of 262 species, not a tenth part of which, Mr. Gardner anticipates, would survive a rigorous examination. The study of only one group of plants—the Gymnosperms—has been the serious business of the past three years; for not only have I had to study, but in the majority of cases to find the specimens as well. I trust that the results attending the expenditure of the grant I have been favoured with may be considered satisfactory, and these I now proceed to detail.

*Bracklesham Flora.*—Two visits have been made to Selsey. The beds, it is well known, are marine, but a few terrestrial fruits are from time to time procured from them. I was able to make a large collection of fossil shells while looking for plants, which, being from the highest beds, are less known, and are interesting as illustrating the passage from the Bracklesham to the Barton fauna, which is more gradual, I think, than is supposed. The surface of one of these beds is dotted over with fossil *Posidonias*, a marine monocotyledonous plant identical with the species now inhabiting the Mediterranean. It had not been previously recorded as a British fossil, though another species is abundant in the contemporary beds of the *Calcaire grossier* of the Paris basin. In our species the rhizomes radiate from a centre, whilst in the French and other European fossil species they are long and branching. They are found among beautiful *Tellina* shells, preserving, to a large extent, their banded colours. The only other fossil plant to record here is a *Nipadites*, which, unlike those of the Bournemouth beds, is large, flattened, and oval.

*Reading Beds.*—A considerable portion of the grant has been expended in working these beds with, I am pleased to report, the happiest results. The flora is found in the Katesgrove pit, on the banks of the Kennet, immediately beneath the mottled clay. The matrix is a fine porcelainous fuller's earth interstratified with sand, and the beds seem very local. The limit of the pit being reached, it is not probable that any part of the beds will be exposed for long. I have illustrated a beautiful specimen—one of several—of *Anemia subcretacea*, Sap., from these beds. This fern is highly characteristic of the lower Eocenes in France, but had only previously been found in the middle Bagshot beds of Bournemouth in this country. I have also illustrated another fern (?) from these beds, of which I have only as yet found a small fragment. The figures are therefore taken from specimens found many years ago by Prof. Prestwich. Other valuable additions to the Reading flora are some splendid specimens of a conifer, which I can see no ground for distinguishing from *Taxodium heterophyllum* of China. Another interesting specimen from Reading is a pine leaf of two needles, about the size and substance of those of *P. maritima*, the first pine foliage, I believe, ever found in the English Eocene. One leaf bed is almost wholly made up of leaves of *Plutonis*, and a bed above is fairly sprinkled with fruits of the same. Fruits are very abundant, and include four kinds of leguminous pods, and there are many flowers. As a result of this work the Reading [illegible] no longer appears so completely distinct from that of [illegible]mouth.

[illegible] *Beds.*—I regard these as thoroughly distinct in age [illegible] of Reading. I have not found, in the course of two [illegible] for the purpose, any bed worth collecting from, [illegible] such must exist at Lewisham.

[illegible] *Beds.*—We were able to reach a leaf bed in the [illegible] at Studland, and to obtain a great number of [illegible] all of which are quite new to me. They are [illegible] leaves and fruits, which will require time [illegible] no Coniferæ among them, and I am [illegible]—a *Lygodium*, very near to that of [illegible] *Chrysodium langeanum*, procured abund[illegible] in a different bed at the same [illegible]

[illegible] *Salvinia* to the flora, not [illegible] exclusively confined to [illegible]

[illegible] from Highcliff was [illegible] found at Bracklesham. The beds are rapidly assuming an angle of repose, and becoming deeply buried under *débris*, so that some of them are no longer visible except by making excavations. Though the Barton series is one of the most interesting of our Eocene formations, the detailed bedding has not been worked out like that of the Bracklesham series below and the Headon series above, and the greatest misconceptions seem to prevail as to the number of species of fossils that it contains.

*Bournemouth Beds.*—Five series of leaves were obtained this year by Mr. Keeping and myself, the most noteworthy of which are some specimens of *Godoya* which exceed any I had previously seen. I have illustrated a new and very distinct species of *Adiantum*, a fragment of what may be *Gymnogramma*, and a trifid group of *Polypodium* leaves, which seem to be different from either of the species previously recorded.

*The London Clay.*—Mr. Shrubsole has kindly sent me some of the best of the fruits that have been found. I have not made any complete studies of them yet, but they promise to afford results of the highest value. Among a few recognised is the very unmistakable seed of *Verschaffeltia*, a genus of palms from Seychelles quite new to fossil floras.

*Gurnet Bay Beds.*—I have been able to ascertain that another fern rivals *Anemia subcretacea* in range, *Chrysodium langeanum*, which extends from the town of Bagshot upwards into the Bembridge beds. The plants are as a rule dreadfully macerated and chopped up. Among them are small fragments of a *Gleichenia*, which, though not very beautiful, is a very important fern, coming from the horizon. By far the most important discovery, however, is that of *Doliostrobus*, the first really extinct conifer that I have met with in British Eocenes. It belonged to the tribe of *Araucariae*, and its identification has been thoroughly confirmed by correspondence and the interchange of specimens with Dr. Marion, the well-known botanist of Marseilles. It is certain that during the Eocene period, as the temperature increased from the base upward to the Middle Bagshot, when the maximum of heat seems to have prevailed, there was a tendency for the plant world to move northward. It is equally certain that in the later half of the Eocene, as the temperature began to decrease, the movement was in the opposite direction, and we find in the European Miocenes of Switzerland and Italy a number of plants that at an earlier period were growing in the far north.

*Report of the Committee, consisting of H. Bauerman, F. W. Rudler, and Dr. H. Johnston Lavis, for the Investigation of the Volcanic Phenomena of Vesuvius, by H. Johnston Lavis, M.D., F.G.S., Reporter.*—The unfortunate outbreak of cholera in Naples and the stringent local quarantine measures prevented work on Vesuvius being carried out during the autumn of 1884. Nevertheless, daily observations were made of the variations in the activity of the volcano, of which a careful record has been kept. All important changes of the crater-plain, and in the cone of eruption, have been photographed. Descriptions of the small eruption of May 2 of 1885 have already been given in NATURE, and the results of a microscopical examination of the sides of the remarkable hollow dyke then formed will soon be published. The Naples section of the Italian Alpine Club have generously undertaken to publish a journal of Vesuvius, which will contain reproductions of the photographs exhibited. The third sheet of the geological map of Vesuvius and Monte Somnia (scale 1 : 10,000) has been completed by the reporter, and is exhibited at the meeting. The relationship of the varying activity of a volcano in a Strombolian state of activity to barometric pressure, the lunar tides, and rainfall, cannot but be regarded as important in solving some questions of vulcanology. Instrumental means of measuring such present so many practical difficulties that a scale of activity has been drawn up, which requires only a few minutes to learn, can be practised by any one with good eyesight and moderate intelligence who is within visual range of the volcano, and, above all, requires no further outlay than pen, ink, and paper. The objections will be mentioned after describing the process. 1st degree, a faint red glimmer above the main vent interrupted by complete darkness; 2nd degree, the glimmer is continuous, but the ejection reaches hardly above the central crater rim at the most; 3rd degree, glimmer continuous and well marked; the ejections are distinctly discernible as they rise and then fall on the slopes of the cone of eruption and roll down its slopes; 4th degree, the ejections reach a considerable height, are brilliant, and light up the top of the great cone; 5th degree, verging on an actual paroxysmal eruption, the ejections are shot up very high, being only very slightly or not at all influenced in their course by a strong wind. Each explosion follows with much rapidity, and corresponds with the "boati" heard all around the west, south, and south-east slopes of the mountain. The objections to this method of registering the variations in the activity of a volcano are: (*a*) cloud-cap, which may for days cut off the view; (*b*) after a great eruption, resulting in a deep crater, the changes of activity would be invisible from the neighbourhood of the mountain; (*c*) it is only applicable after dark, so that usually only one observation a day can be made; (*d*) should lava be flowing from a lateral outlet, as is often the case, the level of the fluid in the chimney would vary as the outflow took place with greater or less rapidity, dependent on its blocking the passage more or less. The reporter thinks it desirable to introduce a description of this method into the report, so that it may be made use of in the case of other suitable volcanoes.

*Report of the Committee, consisting of Prof. Ray Lankester, Mr. P. L. Sclater, Prof. M. Foster, Mr. A. Sedgwick, Prof. A. M. Marshall, Prof. A. C. Haddon, Prof. Moseley, and Mr. Percy Sladen (Secretary), appointed for the purpose of arranging for the occupation of a Table at the Zoological Station at Naples.* —In the Report read last year at Montreal it was announced that a scheme was on foot for the building of a large physiological laboratory in connection with the Zoological Station at Naples, and for the purchase of a new sea-going steamer, to be equipped as a floating laboratory. Your Committee are now able to report that both these projects are steadily advancing towards attainment. For the physiological laboratory the Municipality of Naples has made a grant of 400 square metres of ground, and the Italian Parliament has voted the sum of 50,000 lire towards the cost of building. In addition to this assistance from the Italian Government, a union of the maritime provinces of South Italy is about to be formed for the purpose of contributing towards the cost of the new laboratory, and of maintaining two tables there for the use of natives of the provinces concerned. The new steamship, which it is hoped will shortly be in the possession of the station, will form a further addition to the capabilities of the establishment. This undertaking is in the hands of an influential committee in Germany, organised for the purpose of collecting subscriptions, and by whom the vessel will be presented to the station. It is intended that the steamer should be of 300 to 400 tons burden, with engines of 150 to 200 horse-power, and be fitted up in all respects as a floating laboratory. With such a vessel it will be perfectly practicable to remain weeks or months in any desired locality, and distance from home will be no obstacle, as naturalists will live and work on board. Concurrent with these strides of the Zoological Station, improvements in the general management, in methods of work, and in instruments of research are constantly being made. The general efficiency of the establishment is so well known that it will suffice to say that the whole organisation of the station is in a state of active and prosperous vitality. The best evidence of this is furnished by the accompanying lists:—(1) of the naturalists who have occupied tables during the past year, and (2) of the publications resulting from work carried out at the station.

*The General Collections.*—Additions have been again received from Capt. Chierchia, who has, since the last Report, sent two collections of specimens from the Pacific and Indian Oceans. Other collections have been likewise received from Lieut. Cercone, Lieut. Orsini, and Lieut. Colombo, from the Atlantic, the Red Sea, and the Mediterranean respectively. Some of the material previously obtained by Capt. Chierchia has already been utilised by Count Bela Haller in a paper on the molluscan kidney, recently published; and the same author is at present preparing a monograph on the Patellæ. In like manner the Pteropoda have been investigated by Dr. Boas, of Copenhagen, whose monograph upon the subject is now in the press. Since the last Report the British Associat[illegible] been occupied by Mr. Wm. E. Hoyle, who, [illegible] in time, was enabled to prosecute research[illegible] of the Cephalopoda, and to collect m[illegible] results may be expected. The [illegible] Mr. Hoyle is appended:—

*Report on the Occupation of the* [illegible] *William E. Hoyle.*—I reached Naples on April 6, [illegible] of the same month. In so short a time [illegible] possible to make anything of the nature [illegible] gation in a subject of such magnitude a[illegible] embryology of the Cephalopoda; it seemed, therefore, that the opportunities afforded me could best be utilised by collecting material for subsequent examination. Of this I had an abundant and immediate supply, thanks to the kindly forethought of your secretary, who had given notice to the authorities of the station of the nature of the work I had undertaken, so that they had a quantity of ova ready for my use. The greater part of my time was spent in extracting embryos from the egg and preserving them in various fluids, and a fairly complete series of developmental stages of *Loligo* and a good many embryos of *Sepia* were thus obtained. When the young Cephalopods have reached a stage at which the rudiments of the arms are clearly visible, it is moderately easy, after a little practice, to extricate them by making an incision into the egg-membrane with a fine scalpel; but previously to this period they so nearly occupy the whole interior of the egg that it is almost impossible to obtain them uninjured. A quantity of such eggs I preserved whole by a method suggested to me by Dr. Jatta, who is at work upon a monograph of the Cephalopoda of the Bay of Naples. The strings of eggs are placed whole in weak solution of chromic acid (about 0·25 per cent.) for a few hours, and then in distilled water for twenty-four hours, after which they are preserved in alcohol. The embryos can then be extracted much more readily than when fresh. Some time was devoted to examining and drawing the embryos in the fresh condition, and in watching the process of segmentation in *Loligo* and *Sepia*. I observed the presence of the "Richtungsbläschen" in the former, which, so far as I am aware, has only been noted in a Russian memoir on the development of *Sepiola* by Ussow. A number of blastoderms in process of segmentation were preserved according to a method proposed by Ussow, for the knowledge of which I am indebted to Dr. Edward Meyer, who kindly translated it for me from the original. The egg, without removal of the membranes, is placed in 2 per cent. solution of chromic acid for two minutes, and then in distilled water, to which a little acetic acid (one drop to a watchglassful) has been added, for two minutes longer. If an incision be now made into the egg-membrane the yolk flows away and the blastoderm remains; if any yolk still cling to it, it may be removed by pouring away the water and adding more. The blastoderms thus prepared show, when appropriately stained, fine karyokinetic figures, of which I hope shortly to publish an account. The reduction of the collected embryos to serial sections and their examination will of course occupy some time, but I hope in a few months to prepare some account of the results obtained from them.

*Report of the Committee, consisting of Prof. Huxley, Mr. Sclater, Mr. Howard Saunders, Mr. Thiselton Dyer, and Prof. Moseley (Secretary), appointed for the purpose of promoting the Establishment of Marine Biological Stations on the Coast of the United Kingdom.*—The Committee has received the sum granted (150*l.*) from the Treasurer of the Association, and has paid it to the funds of the Marine Biological Association of the United Kingdom, as the most direct means of promoting the speedy establishment of a marine laboratory in a most favourable situation on the British coast—namely, Plymouth. An excellent site for a laboratory has been granted to the Marine Biological Association by Government, at Plymouth. A sum of 8000*l.* has been raised by subscriptions and donations, the Government has promised to aid the working of the laboratory by an annual [illegible] there is every prospect of success. It is probable [illegible] of the laboratory will commence in November [illegible]

*Report of the Committee, consisting of* [illegible] *Canon Tristram,* [illegible] *and* [illegible] *(Secretary),* [illegible] *of* [illegible] *Palestine.*—[illegible] Palestine [illegible] during the last [illegible] Herr S[illegible] L. [illegible] by Mr. [illegible] who has [illegible] with [illegible] called [illegible] Herr Sch[illegible] an area [illegible] the hands [illegible] memoirs [illegible] with [illegible] has been laid [illegible]

Natural History memoir, made from new observations during the same journey. In addition the Committee have received from Mr. Guy Le Strange, and published, observations and notes made by him during a recent journey east of Jordan. The results of the survey, so far as it has been completed, will appear in a map reduced to a scale of about three miles to an inch, showing the country on both sides of the river Jordan, instead of on the western side only. This portion of the work is under the direction of Col. Sir Charles Wilson, K.C.M.G., F.R.S. The Society has also issued during the last year a popular account, by Prof. Hule, of his recent journey, called "Mount Seir," and reprints of Capt. Conder's popular books, "Tent Work in Palestine" and "Heth and Moab." Finally, the Committee have completed the issue of their great work, the "Survey of Western Palestine," with the last volumes of "Jerusalem," the "Flora and Fauna," and a portfolio of plates showing the excavations and their results.

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## SECTION H

### ANTHROPOLOGY

OPENING ADDRESS BY FRANCIS GALTON, F.R.S., ETC., PRESIDENT OF THE ANTHROPOLOGICAL INSTITUTE, PRESIDENT OF THE SECTION

THE object of the Anthropologist is plain. He seeks to learn what mankind really are in body and mind, how they came to be what they are, and whither their races are tending; but the methods by which this definite inquiry has to be pursued are extremely diverse. Those of the geologist, the antiquarian, the jurist, the historian, the philologist, the traveller, the artist, and the statistician, are all employed, and the Science of Man progresses through the help of specialists. Under these circumstances, I think it best to follow an example occasionally set by presidents of sections, by giving a lecture rather than an address, selecting for my subject one that has long been my favourite pursuit, on which I have been working with fresh data during many recent months, and about which I have something new to say.

My data were the Family Records entrusted to me by persons living in all parts of the country, and I am now glad to think that the publication of some first-fruits of their analysis will show to many careful and intelligent correspondents that their painstaking has not been thrown away. I shall refer to only a part of the work already completed, which in due time will be published, and must be satisfied if, when I have finished this address, some few ideas that lie at the root of heredity shall have been clearly apprehended, and their wide bearings more or less distinctly perceived. I am the more desirous of speaking on heredity, because, judging from private conversations and inquiries that are often put to me, the popular views of what may be expected from inheritance seem neither clear nor just.

The subject of my remarks will be "Types and their Inheritance." I shall discuss the conditions of the stability and instability of types, and hope in doing so to place beyond doubt the existence of a simple and far-reaching law that governs hereditary transmission, and to which I once before ventured to draw attention, on far more slender evidence than I now possess.

It is some years since I made an extensive series of experiments on the produce of seeds of different size but of the same species. They yielded results that seemed very noteworthy, and I used them as the basis of a lecture before the Royal Institution on February 9, 1877. It appeared from these experiments that the offspring did *not* tend to resemble their parent seeds in size, but to be always more mediocre than they—to be smaller than the parents, if the parents were large; to be larger than the parents, if the parents were very small. The point of convergence was considerably below the average size of the seeds contained in the large bagful I bought at a nursery-garden, out of which I selected [illegible] that were sown.

[illegible] experiments showed further that the mean filial regression [illegible] mediocrity was directly proportional to the parental [illegible] from it. This curious result was based on so many [illegible] conducted for me by friends living in various parts of [illegible] Nairn in the north to Cornwall in the south, [illegible] three generations of the plants, that I [illegible] of the truth of my conclusions. The exact ratio of regression remained a little doubtful, owing to variable influences; therefore I did not attempt to define it. After the lecture had been published, it occurred to me that the grounds of my misgivings might be urged as objections to the general conclusions. I did not think them of moment, but as the inquiry had been surrounded with many small difficulties and matters of detail, it would be scarcely possible to give a brief and yet a full and adequate answer to such objections. Also, I was then blind to what I now perceive to be the simple explanation of the phenomenon, so I thought it better to say no more upon the subject until I should obtain independent evidence. It was anthropological evidence that I desired, caring only for the seeds as means of throwing light on heredity in man. I tried in vain for a long and weary time to obtain it in sufficient abundance, and my failure was a cogent motive, together with others, in inducing me to make an offer of prizes for family records, which was largely responded to, and furnished me last year with what I wanted. I especially guarded myself against making any allusion to this particular inquiry in my prospectus, lest a bias should be given to the returns. I now can securely contemplate the possibility of the records of height having been frequently drawn up in a careless fashion, because no amount of unbiassed inaccuracy can account for the results, contrasted in their values but concurrent in their significance, that are derived from comparisons between different groups of the returns.

An analysis of the records fully confirms and goes far beyond the conclusions I obtained from the seeds. It gives the numerical value of the regression towards mediocrity as from 1 to $\frac{2}{3}$ with unexpected coherence and precision, and it supplies me with the class of facts I wanted to investigate—the degrees of family likeness in different degrees of kinship, and the steps through which special family peculiarities become merged into the typical characteristics of the race at large.

The subject of the inquiry on which I am about to speak was Hereditary Stature. My data consisted of the heights of 930 adult children and of their respective parentages, 205 in number. In every case I transmuted the female statures to their corresponding male equivalents and used them in their transmuted form, so that no objection grounded on the sexual difference of stature need be raised when I speak of averages. The factor I used was 1·08, which is equivalent to adding a little less than one-twelfth to each female height. It differs a very little from the factors employed by other anthropologists, who, moreover, differ a trifle between themselves; anyhow it suits my data better than 1·07 or 1·09. The final result is not of a kind to be affected by these minute details, for it happened that, owing to a mistaken direction, the computer to whom I first entrusted the figures used a somewhat different factor, yet the result came out closely the same.

I shall explain with fulness why I chose stature for the subject of inquiry, because the peculiarities and points to be attended to in the investigation will manifest themselves best by doing so. Many of its advantages are obvious enough, such as the ease and frequency with which its measurement is made, its practical constancy during thirty-five years of middle life, its small dependence on differences of bringing up, and its inconsiderable influence on the rate of mortality. Other advantages which are not equally obvious are no less great. One of these lies in the fact that stature is not a simple element, but a sum of the accumulated lengths or thicknesses of more than a hundred bodily parts, each so distinct from the rest as to have earned a name by which it can be specified. The list of them includes about fifty separate bones, situated in the skull, the spine, the pelvis, the two legs, and the two ankles and feet. The bones in both the lower limbs are counted, because it is the average length of these two limbs that contributes to the general stature. The cartilages interposed between the bones, two at each joint, are rather more numerous than the bones themselves. The fleshy parts of the scalp of the head and of the soles of the feet conclude the list. Account should also be taken of the shape and set of many of the bones which conduce to a more or less arched instep, straight back, or high head. I noticed in the skeleton of O'Brien, the Irish giant, at the College of Surgeons, which is, I believe, the tallest skeleton in any museum, that his extraordinary stature of about 7 feet 7 inches would have been a trifle increased if the faces of his dorsal vertebræ had been more parallel and his back consequently straighter.

The beautiful regularity in the statures of a population, whenever they are statistically marshalled in the order of their heights, is due to the number of variable elements of which the stature is the sum. The best illustrations I have seen of this regularity were the curves of male and female statures that I obtained from the careful measurements made at my Anthropometric Laboratory in the International Health Exhibition last year. They were almost perfect.

The multiplicity of elements, some derived from one progenitor, some from another, must be the cause of a fact that has proved very convenient in the course of my inquiry. It is that the stature of the children depends closely on the average stature of the two parents, and may be considered in practice as having nothing to do with their individual heights. The fact was proved as follows:—After transmuting the female measurements in the way already explained, I sorted the children of parents who severally differed 1, 2, 3, 4, and 5, or more inches into separate groups. Each group was then divided into similar classes, showing the number of cases in which the children differed 1, 2, 3, &c., inches from the common average of the children in their respective families. I confined my inquiry to large families of six children and upwards, that the common average of each might be a trustworthy point of reference. The entries in each of the different groups were then seen to run in the same way, except that in the last of them the children showed a faint tendency to fall into two sets, one taking after the tall parent, the other after the short one. Therefore, when dealing with the transmission of stature from parents to children, the average height of the two parents, or, as I prefer to call it, the "mid-parental" height, is all we need care to know about them.

It must be noted that I use the word parent without specifying the sex. The methods of statistics permit us to employ this abstract term, because the cases of a tall father being married to a short mother are balanced by those of a short father being married to a tall mother. I use the word "parent" to save a complication due to a fact brought out by these inquiries, that the height of the children of both sexes, but especially that of the daughters, takes after the height of the father more than it does after that of the mother. My present data are insufficient to determine the ratio satisfactorily.

Another great merit of stature as a subject for inquiries into heredity is that marriage selection takes little or no account of shortness or tallness. There are undoubtedly sexual preferences for moderate contrast in height, but the marriage choice appears to be guided by so many and more important considerations that questions of stature exert no perceptible influence upon it. This is by no means my only inquiry into this subject, but, as regards the present data, my test lay in dividing the 205 male parents and the 205 female parents each into three groups—tall, medium, and short (medium being taken as 67 inches and upwards to 70 inches)—and in counting the number of marriages in each possible combination between them. The result was that men and women of contrasted heights, short and tall or tall and short, married just about as frequently as men and women of similar heights, both tall or both short; there were 32 cases of the one to 27 of the other. In applying the law of probabilities to investigations into heredity of stature, we may regard the married folk as couples picked out of the general population at haphazard.

The advantages of stature as a subject in which the simple laws of heredity may be studied will now be understood. It is a nearly constant value that is frequently measured and recorded, and its discussion is little entangled with considerations of nurture, of the survival of the fittest, or of marriage selection. We have only to consider the mid-parentage and not to trouble ourselves about the parents separately. The statistical variations of stature are extremely regular, so much so that their general conformity with the results of calculations based on the abstract law of frequency of error is an accepted fact by anthropologists. I have made much use of the properties of that law in cross-testing my various conclusions, and always with success.

The only drawback to the use of stature is its small variability. One half of the population with whom I dealt varied less than 1·7 inch from the average of all of them, and one-half of the offspring of similar mid-parentages varied less than 1·5 inch from the average of their own heights. On the other hand, the precision of my data is so small, partly due to the uncertainty in many cases whether the height was measured with the shoes on or off, that I find by means of an independent inquiry that each observation, taking one with another, is liable to an error that as often as not exceeds ⅗ of an inch.

It must be clearly understood that my inquiry is primarily into the inheritance of different degrees of tallness and shortness. That is to say, of measurements made from the crown of the head to the level of mediocrity, upwards or downwards as the case may be, and not from the crown of the head to the ground. In the population with which I deal, the level of mediocrity is 68¼ inches (without shoes). The same law, applying with sufficient closeness both to tallness and shortness, we may include both under the single head of deviations, and I shall call any particular deviation a "deviate." By the use of this word and that of "mid-parentage," we can define the law of regression very briefly. It is that the height-deviate of the offspring is, on the average, two-thirds of the height-deviate of its mid-parentage.

If this remarkable law had been based only on experiments on the diameters of the seeds, it might well be distrusted until confirmed by other inquiries. If it were corroborated merely by the observations on human stature, of which I am about to speak, some hesitation might be expected before its truth could be recognised in opposition to the current belief that the child tends to resemble its parents. But more can be urged than this. It is easily to be shown that we ought to expect filial regression, and that it should amount to some constant fractional part of the value of the mid-parental deviation. It is because this explanation confirms the previous observations made both on seeds and on men, that I feel justified on the present occasion in drawing attention to this elementary law.

The explanation of it is as follows. The child inherits partly from his parents, partly from his ancestry. Speaking generally, the further his genealogy goes back, the more numerous and varied will his ancestry become, until they cease to differ from any equally numerous sample taken at haphazard from the race at large. Their mean stature will then be the same as that of the race; in other words, it will be mediocre. Or, to put the same fact into another form, the most probable value of the mid-ancestral deviates in any remote generation is zero.

For the moment let us confine our attention to the remote ancestry and to the mid-parentages, and ignore the intermediate generations. The combination of the zero of the ancestry with the deviate of the mid-parentage, is that of nothing with something, and the result resembles that of pouring a uniform proportion of pure water into a vessel of wine. It dilutes the wine to a constant fraction of its original alcoholic strength, whatever that strength may have been.

The intermediate generations will each in their degree do the same. The mid-deviate of any one of them will have a value intermediate between that of the mid-parentage and the zero value of the ancestry. Its combination with the mid parental deviate will be as if, not pure water, but a mixture of wine and water in some definite proportion had been poured into the wine. The process throughout is one of proportionate dilutions, and therefore the joint effect of all of them is to weaken the original wine in a constant ratio.

We have no word to express the form of that ideal and composite progenitor, whom the offspring of similar mid-parentages most nearly resemble, and from whose stature their own respective heights diverge evenly, above and below. He, she, or it, may be styled the "generant" of the group. I shall shortly explain what my notion of a generant is, but for the moment it is sufficient to show that the parents are not identical with the generant of their own offspring.

The average regression of the offspring to a constant fraction of their respective mid-parental deviations, which was first observed in the diameters of seeds, and then confirmed by observations on human stature, is now shown to be a perfectly reasonable law which might have been deductively foreseen. It is of so simple a character that I have made an arrangement with one movable pulley and two fixed ones by which the probable average height of the children of known parents can be mechanically reckoned. This law tells heavily against the full hereditary transmission of any rare and valuable gift, as only a few of many children would resemble their mid-parentage. The more exceptional the gift, the more exceptional will be the good fortune of a parent who has a son who equals, and still more if he has a son who overpasses him. The law is even-handed; it levies the same heavy succession-tax on the transmission of badness as well as of goodness. If it discourages the extravagant expectations of gifted parents that their children will inherit all their powers, it no less discountenances extravagant fears that they will inherit all their weaknesses and diseases.

The converse of this law is very far from being its numerical opposite. Because the most probable deviate of the son is only two-thirds that of his mid-parentage, it does not in the least follow that the most probable deviate of the mid-parentage is $\frac{3}{2}$, or $1\frac{1}{2}$ that of the son. The number of individuals in a population who differ little from mediocrity is so preponderant, that it is more frequently the case that an exceptional man is the somewhat exceptional son of rather mediocre parents, than the average son of very exceptional parents. It appears from the very same table of observations by which the value of the filial regression was determined, when it is read in a different way, namely, in vertical columns instead of in horizontal lines, that the most probable mid-parentage of a man is one that deviates only one-third as much as the man does. There is a great difference between this value of $\frac{1}{3}$ and the numerical converse mentioned above of $\frac{3}{2}$; it is four and a half times smaller, since $4\frac{1}{2}$, or $\frac{9}{2}$, being multiplied into $\frac{1}{3}$, is equal to $\frac{3}{2}$.

Let it not be supposed for a moment that these figures invalidate the general doctrine that the children of a gifted pair are much more likely to be gifted than the children of a mediocre pair. What it asserts is that the ablest child of one gifted pair is not likely to be as gifted as the ablest of all the children of very many mediocre pairs. However, as, notwithstanding this explanation, some suspicion may remain of a paradox lurking in these strongly contrasted results, I will explain the form in which the table of data was drawn up, and give an anecdote connected with it. Its outline was constructed by ruling a sheet into squares, and writing a series of heights in inches, such as 60 and under 61, 61 and under 62, &c., along its top, and another similar series down its side. The former referred to the height of offspring, the latter to that of mid-parentages. Each square in the table was formed by the intersection of a vertical column with a horizontal one, and in each square was inserted the number of children out of the 930 who were of the height indicated by the heading of the vertical column, and who at the same time were born of mid-parentages of the height indicated at the side of the horizontal column. I take an entry out of the table as an example. In the square where the vertical column headed[1] 69– is intersected by the horizontal column by whose side 67– is marked, the entry 38 is found; this means that out of the 930 children 38 were born of mid-parentages of 69 and under 70 inches, who also were 67 and under 68 inches in height. I found it hard at first to catch the full significance of the entries in the table, which had curious relations that were very interesting to investigate. Lines drawn through entries of the same value formed a series of concentric and similar ellipses. Their common centre lay at the intersection of the vertical and horizontal lines, that corresponded to $68\frac{1}{4}$ inches. Their axes were similarly inclined. The points where each ellipse in succession was touched by a horizontal tangent, lay in a straight line inclined to the vertical in the ratio of $\frac{2}{3}$; those where they were touched by a vertical tangent, lay in a straight line inclined to the horizontal in the ratio of $\frac{1}{3}$. These ratios confirm the values of average regression already obtained by a different method, of $\frac{2}{3}$ from mid-parent to offspring, and of $\frac{1}{3}$ from offspring to mid-parent. These and other relations were evidently a subject for mathematical analysis and verification. They were all clearly dependent on three elementary data, supposing the law of frequency of error to be applicable throughout; these data being (1) the measure of racial variability, (2) that of co-family variability (counting the offspring of like mid-parentages as members of the same co-family), and (3) the average ratio of regression. I noted these values, and phrased the problem in abstract terms such as a competent mathematician could deal with, disentangled from all reference to heredity, and in that shape submitted it to Mr. J. Hamilton Dickson, of St. Peter's College, Cambridge. I asked him kindly to investigate for me the surface of frequency of error that would result from these three data, and the various particulars of its sections, one of which would form the ellipses to which I have alluded.

I may be permitted to say that I never felt such a glow of loyalty and respect towards the sovereignty and magnificent sway of mathematical analysis as when his answer reached me, confirming, by purely mathematical reasoning, my various and laborious statistical conclusions with far more minuteness than I had dared to hope, for the original data ran somewhat roughly, and I had to smooth them with tender caution. His calculation corrected my observed value of mid-parental regression from $\frac{1}{3}$ to $\frac{6}{17 \cdot 6}$, the relation between the major and minor axis of the ellipses was changed 3 per cent., their inclination was changed less than 2°. It is obvious, then, that the law of error holds throughout the investigation with sufficient precision to be of real service, and that the various results of my statistics are not casual determinations, but strictly interdependent.

In the lecture at the Royal Institution to which I have referred, I pointed out the remarkable way in which one generation was succeeded by another that proved to be its statistical counterpart. I there had to discuss the various agencies of the survival of the fittest, of relative fertility and so forth; but the selection of human stature as the subject of investigation now enables me to get rid of all these complications, and to discuss this very curious question under its simplest form. How is it, I ask, that in each successive generation there proves to be the same number of men per thousand who range between any limits of stature we please to specify, although the tall men are rarely descended from equally tall parents, or the short men from equally short? How is the balance from other sources so nicely made up? The answer is that the process comprises two opposite sets of actions, one concentrative and the other dispersive, and of such a character that they necessarily neutralise one another, and fall into a state of stable equilibrium. By the first set, a system of scattered elements is replaced by another system which is less scattered; by the second set, each of these new elements becomes a centre whence a third system of elements are dispersed. The details are as follows:—In the first of these two stages, the units of the population group themselves, as it were by chance, into married couples, whence the mid-parentages are derived, and then by a regression of the values of the mid-parentages the true generants are derived. In the second stage each generant is a centre whence the offspring diverge. The stability of the balance between the opposed tendencies is due to the regression being proportionate to the deviation; it acts like a spring against a weight.

A simple equation connects the three data of race variability, of the ratio of regression, and of co-family variability, whence, if any two are given, the third may be found. My observations give separate measures of all three, and their values fit well into the equation, which is of the simple form—

$$v^2 \frac{p^2}{2} + f^2 = p^2,$$

where $v = \frac{2}{3}$, $p = 1 \cdot 7$, $f = 1 \cdot 5$.

It will therefore be understood that a complete table of mid-parental and filial heights may be calculated from two simple numbers.

It will be gathered from what has been said, that a mid-parental deviate of one unit implies a mid-grandparental deviate of $\frac{1}{3}$, a mid-ancestral unit in the next generation of $\frac{1}{9}$, and so on. I reckon from these and other data, by methods that I cannot stop to explain, that the heritage derived on an average from the mid-parental deviate, independently of what it may imply, or of what may be known concerning the previous ancestry, is only $\frac{1}{2}$. Consequently, that similarly derived from a single parent is only $\frac{1}{4}$, and that from a single grandparent is only $\frac{1}{16}$.

The most elementary data upon which a complete table of mid-parental and filial heights admits of being constructed are (1) the ratio between the mid-parental and the rest of the ancestral influences, and (2) the measure of the co-family variability.

I cannot now pursue the numerous branches that spring from the data I have given, as from a root. I will not speak of the continued domination of one type over others, nor of the persistency of unimportant characteristics, nor of the inheritance of disease, which is complicated in many cases by the requisite concurrence of two separate heritages, the one of a susceptible constitution, the other of the germs of the disease. Still less can I enter upon the subject of fraternal characteristics, which I have also worked out. It will suffice for the present to have shown some of the more important conditions associated with the idea of race, and how the vague word "type" may be defined by peculiarities in hereditary transmission, at all events when that word is applied to any single quality, such as stature. To include those numerous qualities that are not strictly measurable, we must omit reference to number and proportion, and frame the definition thus:—"The type is an ideal form towards which the children of those who deviate from it tend to regress."

The stability of a type would, I presume, be measured by the

[1] A matter of detail is here ignored which has nothing to do with the main principle, and would only serve to perplex if I described it.

strength of its tendency to regress; thus a mean regression from 1 in the mid-parents to $\frac{2}{3}$ in the offspring would indicate only half as much stability as if it had been to $\frac{1}{3}$.

The mean regression in stature of a population is easily ascertained, but I do not see much use in knowing it. It has already been stated that half the population vary less than 1·7 inch from mediocrity, this being what is technically known as the "probable" deviation. The mean deviation is, by a well-known theory, 1·18 times that of the probable deviation, therefore in this case it is 1·9 inch. The mean loss through regression is $\frac{1}{3}$ of that amount, or a little more than 0·6 inch. That is to say, taking one child with another, the mean amount by which they fall short of their mid-parental peculiarity of stature is rather more than six-tenths of an inch.

With respect to these and the other numerical estimates, I wish emphatically to say that I offer them only as being serviceably approximate, though they are mutually consistent, and with the desire that they may be reinvestigated by the help of more abundant and much more accurate measurements than those I have had at command. There are many simple and interesting relations to which I am still unable to assign numerical values for lack of adequate material, such as that to which I referred some time back of the superior influence of the father over the mother on the stature of their sons and daughters.

The limits of deviation beyond which there is no regression, but a new condition of equilibrium is entered into, and a new type comes into existence, have still to be explored. Let us consider how much we can infer from undisputed facts of heredity regarding the conditions amid which any form of stable equilibrium, such as is implied by the word "type," must be established, or might be disestablised and superseded by another. In doing so I will follow cautiously along the same path by which Darwin started to construct his provisional theory of pangenesis; but it is not in the least necessary to go so far as that theory, or to entangle ourselves in any questioned hypothesis.

There can be no doubt that heredity proceeds to a considerable extent, perhaps principally, in a piecemeal or piebald fashion, causing the person of the child to be to that extent a mosaic of independent ancestral heritages, one part coming with more or less variation from this progenitor and another from that. To express this aspect of inheritance, where particle proceeds from particle, we may conveniently describe it as "particulate."

So far as the transmission of any feature may be regarded as an example of particulate inheritance, so far (it seems little more than a truism to assert) the element from which that feature was developed must have been particulate also. Therefore, wherever a feature in a child was not personally possessed by either parent, but transmitted through one of them from a more distant progenitor, the element whence that feature was developed must have existed in a particulate, though impersonal and latent, form in the body of the parent. The total heritage of that parent will have included a greater variety of material than was utilised in the formation of his own personal structure. Only a portion of it became developed; the survival of at least a small part of the remainder is proved, and that of a larger part may be inferred by his transmitting it to the person of his child. Therefore the organised structure of each individual should be viewed as the fulfilment of only one out of an indefinite number of mutually exclusive possibilities. It is the development of a single sample drawn out of a group of elements. The conditions under which each element in the sample became selected are, of course, unknown, but it is reasonable to expect they would fall under one or other of the following agencies: first, self-selection, where each element selects its most suitable neighbour, as in the theory of pangenesis; secondly, general co-ordination, or the influence exerted on each element by many or all of the remaining ones, whether in its immediate neighbourhood or not; finally, a group of diverse agencies, alike only in the fact that they are not uniformly helpful or harmful, that they influence with no constant purpose—in philosophical language, that they are not teleological; in popular language, that they are accidents or chances. Their inclusion renders it impossible to predict the peculiarities of individual children, though it does not prevent the prediction of average results. We now see something of the general character of the conditions amid which the stable equilibrium that characterises each race must subsist.

Political analogies of stability and change of type abound, and are useful to fix the ideas, as I pointed out some years [illegible] Let us take that which is afforded by the government of a co[illegible] which has become independent. The individual colonists as particulate representatives of families or other groups in the parent country. The organised colonial government ranks as the personality of the colony, being its mouthpiece and executive. The government is evolved amid political strife, one element prevailing here and another there. The prominent victors band themselves into the nucleus of a party, additions to their number and revisions of it ensue, until a body of men are associated capable of conducting a completely organised administration. The kinship between the form of government of the colony and that of the parent state is far from direct, and resembles in a general way that which I conceive to subsist between the child and his mid-parentage. We should expect to find many points of resemblance between the two, and many instances of great dissimilarity, for our political analogy teaches us only too well on what slight accidents the character of the government may depend when parties are nearly balanced.

The appearance of a new and useful family peculiarity is a boon to breeders, who by selection in mating gradually reduce the preponderance of those ancestral elements that endanger reversion. The appearance of a new type is due to causes that lie beyond our reach, so we ought to welcome every useful one as a happy chance, and do our best to domicile and perpetuate it. When heredity shall have become much better and more generally understood than now, I can believe that we shall look upon a neglect to conserve any valuable form of family type as a wrongful waste of opportunity. The appearance of each new natural peculiarity is a faltering step in the upward journey of evolution, over which, in outward appearance, the whole living world is blindly blundering and stumbling, but whose general direction man has the intelligence dimly to discern, and whose progress he has power to facilitate.

## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

THE meeting of 1885 of the American Association for the Advancement of Science was held at the Ann Arbor University. The total attendance (according to *Science*) of members was not a large one, the number reaching only to 365; the number of papers was 176. Two changes in the organisation were made; by one, the section of histology and microscopy was abolished, as it has been urged for some time that a special science of microscopy does not exist, the microscope being rather a tool to be used by scientific men in various branches. The other change was in the name of the section of mechanics, the words "and engineering" being added to the title, that it may be more clearly understood by Americans that those interested in all branches of engineering are invited to take part in the proceedings. As this was the first meeting since the action of the Government in regard to the Coast Survey, the question was generally discussed. The matter was referred to a committee, which offered to a general session of the Association the following resolutions, which were unanimously accepted:—

WHEREAS, The attention of this Association has been called to articles in the public press, purporting to give—and presumably by authority—an official report of a Commission appointed by the Treasury department to investigate the condition of the U. S. Coast Survey Office, in which report the value of a certain scientific work is designated as "meagre."

AND WHEREAS, This Association desires to express a hope that the decision, as to the utility of such scientific work, may be referred to scientific men.

*Resolved*, That the American Association for the Advancement of Science is in earnest sympathy with the Government in its every intent to secure the greatest possible efficiency of the public service.

*Resolved*, That the value of the scientific work performed in the various departments of the Government can be best judged by scientific men.

*Resolved*, That this [illegible] desires to express its earnest approval of the [illegible] high character of the work [illegible] the U. S. C[illegible] [illegible]ally as illustrated [illegible]

[illegible]

gravity determinations now in progress—and to express the hope that such valuable work may not be interrupted.

*Resolved*, That this Association expresses, also, the hope that the Government will not allow any technical rule to be established that shall necessarily confine its scientific work to its own *employés*.

*Resolved*, That in the opinion of the American Association for the Advancement of Science, the head of the Coast Survey should be appointed by the President, by and with the advice and consent of the Senate, should have the highest possible standing among scientific men, and should command their entire confidence.

*Resolved*, That copies of these resolutions shall be prepared by the general secretary, and certified by the President of the Association and by the permanent secretary, and shall be forwarded to the President of the United States, the Secretary of the Treasury, and given to the press.

Various improvements with the object of securing a more rapid despatch of business were either suggested or adopted; thus members are to be elected by a standing committee instead of in general session, and it is proposed to restrict general sessions of the Association to the beginning and close of the meeting, and to limit the public reading of committee reports in general session to such as seem to the standing committee specially desirable from their interest or importance. The next meeting will be held at Buffalo, beginning August 18, 1886, under the presidency of Prof. Edward S. Morse, of Salem.

We regret much that it is impossible for us to reproduce in full the President's address and the sectional reports; the obvious pressure on our space at the present time will only enable us to refer to a few salient topics. The President's address was delivered by Prof. J. P. Lesley, of Philadelphia. We find the following striking observations on the "dead-work" of science:—

There is a topic which I think should be frequently considered by all who engage in scientific pursuits, and by none so earnestly as by those who are ambitious to reach the higher points of view, from which to survey and describe those systematic combinations of phenomena which are more or less panoramic: I allude of course to generalisers or discoverers of natural laws, and the professional teachers of such laws: while those who deal in itemised science, the mere observers of isolated facts, discriminating specimens and naming genera and species in the animal, vegetable, or mineral worlds, and especially such as occupy themselves with geographical and geological studies in detail, stand in less need of having it pressed upon their attention, because in their case it insists upon its own necessity.

I allude to what is technically known among experts as "dead-work."

This topic has to be treated in the most prosaic style. To describe dead-work is to narrate all those portions of our work which consume the most time, give the most trouble, require the greatest patience and endurance, and seem to produce the most insignificant results. It comprises the collection, collation, comparison and adjustment, the elimination, correction, and reselection, the calculation and representation—in a word, the entire first, second, and third handling of our data in any branch of human learning—wholly perfunctory, preparatory, and mechanical, wholly tentative, experimental, and defensive—without which it is dangerous to proceed a single stage into reasoning on the unknown, and futile to imagine that we can advance in science ourselves, or assist in its advancement in the world. It is that tedious, costly, and fatiguing process of laying a good foundation which no eye is ever to see, for a house to be built thereon for safety and enjoyment, for public uses or for monumental beauty. It is the labour of a week to be paid for on Saturday night. It is the slow recruiting, arming, drilling, victualling, and transporting of an entire army to secure victory in one short battle. It is the burden of dead weight which every great discoverer has had to carry for years and years, unknown to the world at large, before the world was electrified by his appearance as its genius. Let us examine it more closely: it will repay our scrutiny. Those of you who have been more or less successfully at work all your lives may get some satisfaction from the retrospect: and those who have commenced careers should hear what dead-work means, what its uses are, how indispensable it is, how honourable it is, and what stores of health and strength and happiness it reserves for them.

My propositions, then, are these:—(1) That, without a large amount of this dead-work, there can be no discovery of what is rightly called a scientific truth. (2) That, without a large amount of dead-work on the part of a teacher of science, he will fail in his efforts to impart true science to his scholars. (3) That, without a large amount of dead-work, no professional expert can properly serve, much less inform and command, his clients or employers. (4) That nothing but a habitual performance of dead work can keep the scientific judgment in a safe and sound condition to meet emergencies, or prevent it from falling more or less rapidly into decrepitude; and (5) That in the case of highly-organised thinkers, disposed or obliged to exercise habitually the creative powers of the imagination, or to exhaust the will-power in frequently-recurring decisions of difficult and doubtful questions, dead-work and plenty of it is their only salvation; nay, the most delicious and refreshing recreation; a panacea for disgust, discouragement, and care; an elixir vitæ; a fountain of perpetual youth. . . .

First, then, is it so that scientific truths cannot be discovered without a large amount of preliminary dead-work? Surely no one in this assembly doubts it who has established even one original theory for himself, or won for it the suffrages of judges capable of weighing evidence. Now the immense disproportion in numbers between theories broached and theories accepted is the best proof we could have, not only of the value and necessity of dead-work, but of the scarcity of those who depend upon it as a preparatory stage of theorising. And, moreover, not theories only, but simple statements of fact believed and disbelieved—that is, finally accepted or finally rejected—exhibit the like numerical disproportion, and betray a general carelessness or laziness of observers; at all events their manifest lack of appreciation of the value and necessity of the dead-work part of observation, which imperatively must precede any clear mental perception of the simplest phenomenon, before the attempt is made to establish its natural relationships, and present it for acceptance as a part of science.

No; dead work cannot be delegated. The man who cannot himself survey and map his field, measure and draw his sections properly, and perfectly represent with his own pencil the characteristic variations of its fossil forms, has no just right to call himself an expert geologist. These are the badges of initiation; and the only guarantees which one can offer to the world of science that one is a competent observer and a trustworthy generaliser. Nor has one become a true man of science until he has already done a vast amount of this dead work; nor does one continue in his prime, as a man of science, after he has ceased to bring to this test of his own ability to see, to judge, and to theorise, the working and thinking of other men. But enough of this.

My second proposition was that no teacher of science can be successful who does not himself encounter some of the dead work of the explorer and discoverer; who does not discipline his own faculties of perception, reflection, and generalisation, by field-work and office-work, independently of all text-book assistance; who does not himself make at least some of the diagrams, tables, and pictures for his class-room, in as original a spirit and with as much precision of detail as if none such had ever been made before, and these were to remain sole monuments of the genius of investigation. What the true teacher has to do first and foremost is to wake up in youthful minds this spirit of investigation *ab initio*. The crusade against scholastic cramming promises to be successful; but the crusade against pedagogic cramming has hardly yet been organised. How is the scholar to be made an artist if the teacher cannot draw? The instinct of imitation in man is irresistible. Slovenly drawing on the blackboard—sufficient evidence of the teacher's imperfect information and inaccurate conception of facts, the nature of which he only thinks he understands—can do little more than raise a cold fog of suspicion in the class-room, by which the tender sprouts of learning must be either dwarfed or killed. But even slovenly diagrams are preferable to purchased ones; for whatever diminishes the dead-work of a teacher enervates his investigating, and thereby his demonstrating, powers, and lowers him toward the level of his scholars.

Were I dictator I should drive all teachers of science out into the great field of dead-work; force them to go through all the gymnastics of original research and its description, and not permit them to return to their libraries until their notebooks [illegible] own measurements and calculations, sketch[illegible] drawings, severely accurate and logically classi[illegible] compared with those recorded in the books. [illegible] fail to keep in mind is this: that learning is not [illegible], but as Lessing says: Learning is only our know[illegible] the experience of others; knowledge is our own. No [illegible] really comprehends what he himself has not created. [illegible] we know nothing of the universe until we take [illegible] to pieces for inspection, and rebuild it for our understanding. Nor can one man do this for another; each must do it for himself; and all that one can do to help another is to show him how he himself has morsellated and recomposed his small particular share of concrete nature, and inspire him with those vague but hopeful suggestions of ideas which we call learning, but which are not science.

My third proposition was that an expert in practical science can command the respect and confidence of his professional fellows, and through their free suffrages build up his own reputation in the learned and business worlds, only in exact proportion to the amount of good dead-work to which he voluntarily subjects himself. For, although the most of it is necessarily done in secrecy and silence, enough of it leaks out to testify to his honest and diligent self-cultivation; and enough of it must show in the shape of scientific wisdom to make self-evident the fact that he is neither a tyro nor a charlatan. More than once I have heard the merry jest of the Australasian judge quoted with sinister application to experts in science. When a young colleague, just arrived from England, asked him for advice, he answered: Pronounce your decisions, but beware of stating your reasons for them. Many an ephemeral reputation for science has been begot by this shrewd policy; but the best policy to wear well is honesty; and honesty in trade means selling what is genuine, well-made, and durable; and honesty in science means, first, facts well proved, and then conclusions slowly and painfully deduced from facts well proved, in sufficient number and order of arrangement to exhaust alike the subject and the observer. Reap your field so thoroughly that gleaners must despair. Fortify your position, that your most experienced rival can find no point of attack. Lay your plans with such a superfluity of patient carefulness that fate itself can invent no serious emergency. Demonstrate your theory so utterly and evidently that it shall require no defender but itself. Die for your work, that your work may live for ever. Forget yourself, and your work will make you famous. Enslave yourself to it, and it will plant your feet upon the necks of kings, and your mere Yes or No will become a law to multitudes. This is what the dead-work of science, when well done, does for the expert in science.

My fourth proposition—that only the habitual performance of dead-work can preserve the scientific intellect in pristine vigour, and prevent it from becoming stiffened with prejudices, inapt to receive fresh truth, and forgetful of knowledge already won—hardly needs discussion. Human muscles become atrophied by disuse. Men's fortunes shrink and evaporate by mere investment. I pray you to imagine what I wish to say, for it all amounts to this—that the grass will surely grow over a deserted footpath. Let me hurry to the close of this address, which I have found too serious a duty for my liking, and perhaps you also have found it too personal a preachment for yours. One more suggestion, then, and I have done.

My fifth proposition was that the wearied and exhausted intellect will wisely seek refreshment in dead-work.

The physiology of the brain is now sufficiently well understood to permit physicians to prescribe with some assurance for its many ills, and to regulate its restoration to a normal state of health. Its tissues reproduce themselves throughout life if no extraordinary over-balance of decay takes place, if there be no excessive and too long-continued waste. For the majority of mankind, nature provides for the adjustment between con[illegible]tion and reproduction of brain matter, by the alternation [illegible] and night, noise and silence, society and solitude; and [illegible] the substitution of the play of fancy in dreams, for the [illegible] the judgment and the will in waking hours. We follow [illegible] lead of nature when we seek amusement as a remedy for [illegible] We bring into activity a rested portion of the brain, to [illegible] the wearied parts of it to restore [illegible] unhindered.

In Section A Prof. Newton [illegible] a paper upon "The Effect of Small Bodies [illegible] upon the Planet's Velocity."

The former researches of Pro[illegible] meteors [illegible] recognised among astronomers [illegible] of knowledge about the character, distribution, and motion of these minute bodies with which the solar system is filled, especially those which strike our atmosphere and are burned up as meteors. The possible effect of these upon the rotation of the earth, and the revolution of the earth and moon in their orbits, has been subjected to elaborate investigation at the hands of several mathematical astronomers. The recent publications of Mr. Denning, of Bristol, claiming the fixity of long-continuing radiant points of meteor streams, have raised the question of the existence of broad streams of meteoroids moving swiftly through stellar space outside of solar attraction; and any new investigation bearing upon any of these points is more than usually timely. In this paper Prof. Newton has discussed the effect upon the earth's motion of those bodies which do not pass near enough to the earth to be drawn into its atmosphere, but still near enough to be drawn out of their course, and swung for a time in hyperbolic orbits around it. He began by saying that the results of the investigation might perhaps be considered negative as far as measurable quantities in the solar system are concerned, but that they had a mathematical interest, and might possibly have a bearing upon somewhat similar questions in molecular physics, like the kinetic theory of gases. The mathematician and astronomer must be referred to the paper itself, and the results of popular interest may be briefly summarised as follows:—Considering, first, the case of a cylindrical stream of small bodies evenly distributed, and all moving in the same direction with a common velocity past the earth supposed to be in the axis of the cylinder, it is shown that they will communicate to the earth in each unit of time a velocity along the axis: (1) that is proportional to the density of the group; (2) that decreases as the velocity increases nearly inversely as the square of the velocity; (3) that increases as the logarithm of the radius of the cylinder, the radius being measured by a unit differing from the earth's radius by a small quantity, which is a function of the velocity. Second, in the case of a widely-extended group of small bodies evenly distributed in space, and having speeds all equal, but directed towards points evenly distributed over the celestial sphere with the earth moving in a right line through them, it is shown that, for those which do not strike the earth, but only affect it by their attraction, the effect will be an exceedingly minute acceleration of the earth's motion, if the latter *is less than that of the bodies*, even though the group is infinite in extent. If the earth's velocity *is greater than that of the bodies*, their total effect will consist of two parts: a very minute retardation of the earth's motion, depending in amount upon the absolute velocity of the bodies; and another retardation depending upon the assumed extent of the group. In conclusion, the effect of bodies *striking* the earth or moon is manifold greater than that of those only *passing near*; and since it has before been shown that any admissible magnitude of meteroids would make the effect upon the moon's mean motion of those which strike it only a minute fraction of the observed acceleration, still less can any action of those passing near the moon have any appreciable effect.

Papers were also read by Prof. Harkness on the flexure of transit instruments; by Prof. Hough, describing some improvements recently introduced in the printing chronograph, first designed and brought into use by himself at the Dudley Observatory in 1871, by Prof. Burkitt Webb, describing a method of using polar coordinates, by transferring the origin from the centre to the end of the unit radius, thus substituting $(r-1)$ for $r$, and then using the length of the arc and the distance out from its end upon the radius vector, as $x$ and $y$ are used in rectangular coordinates. He found this a very convenient transformation in the application of polar coordinates to the discussion of Amsler's planimeter; and, pointing out, that by substituting infinity for unit-radius in the equations thus transformed, they were reduced to those of rectangular coordinates, he thought this transformation of polar coordinates [illegible] be found generally useful.

In this section also [illegible] presented some results [illegible] observations for [illegible] with the almucantar, as [illegible] devised by [illegible] of the Harvard College [illegible] a year [illegible] promises at least to [illegible] new [illegible] method of attach[illegible] of [illegible] the [illegible], and very [illegible] on [illegible] of its [illegible] far pub[illegible] [illegible] of the [illegible] to the [illegible] and [illegible] ources of systematic error would seem to be almost wholly d to those of varying personal equation in the observation nsits at all speeds and at all inclinations and directions over ntal wires, and to possible systematic difference in atmoc refraction in different azimuths. Mr. Rockwell exhibited results, simply copied from his observing-books, illustrate methods of reduction for time and latitude observations, howing the degree of accuracy that can be attained by the ment in both these directions. They served to show that nstrument when duplicated will give equally good results the one first constructed; and their consideration gave rise very interesting discussion, participated in by many bers, as to the character of work the instrument might be cted to do, in the course of which Mr. Rockwell answered, very entertaining way, many questions, put by various bers, as to the details of observing and reducing, which were before clearly understood on account of the novelty of the k. One of the most important problems which the instrut is specially adapted to investigate, and one which we hope Chandler will soon find time to undertake, is the determina of the declination of fundamental stars south of the equator, ng them to northern stars at corresponding zenith-distances ow the pole. This would seem to be by far the best, perhaps only, method of connecting these together in a way that ll be free from systematic error.

In the Physical Section, the first paper read was by Prof. ngley, on the spectra of some sources of invisible radiations, d on the recognition of hitherto unmeasured wave-lengths. his was followed by one by Mr. Brashear on a practical ethod of working rock-salt surfaces for optical purposes.

Prof. H. S. Carhart presented a paper on surface transmission f electrical discharges, which was an ingenious revision of ork by Prof. Henry. Prof. E. L. Nichols presented some rther notes on the chemical behaviour of magnetic iron, a ontinuation of work described in a paper at the Philadelphia neeting. Major H. E. Alvord of Mountainville, New York, presented the results of telemetric observations at Houghton Farm. This is a method by which changes in temperature are transmitted and recorded electrically; and Major Alvord's results show that, with increasing experience, the records followed more and more satisfactorily the observations made on the mercurial thermometer.

Prof. T. C. Mendenhall called attention to the modifications and improvements already made or desired in electrometers, especially with reference to their use in observations on atmospheric electricity. Observations of this kind have been made regularly for the last year or two; but, as Prof. Mendenhall well said, the meaning of the variations recorded is still a mystery. Prof. A. E. Dolbear read three papers: in one he described a method of studying contact-theory of electricity by means of the telephone. He has found that a click is produced in the telephone every time the circuit is broken between two heterogeneous materials, as copper and zinc. In another paper he referred to his success in employing a Bernstein incandescent lamp for projection purposes; and in the third he described a new galvanic element of high electromotive force and great constancy, consisting of carbon in a saturated solution of bichromate of potash, and sulphuric acid and zinc in a saturated solution of ammonic chloride; nitric acid could be used in place of sulphuric. Mr. A. J. Rogers presented a paper on electrolysis of the salts of the alkaline earth.

Prof. E. D. Nicholls has, by means of a spectro-photometer, described at a previous meeting, compared the spectrum of the unclouded sky with that of the light reflected by magnesium carbonate, illuminated by direct sunlight.

Prof. Wead exhibited a combined spectro-photometer and ophthalmospectroscope.

In the Chemical Section Prof. Nichols delivered an address on chemistry in the service of public health. Amongst the papers are:—Prof. Noyes, on para-nitrobenzoic sulphuride; Dr. Wiley, on a method of estimating lactic and acetic acid in sour milk or *koumiss*; Mr. Young, on the thermo-chemical reaction between potassic hydrade and common alum. A general discussion took place on the question of what is the best initiatory work for students entering upon laboratory practice, and also, To what extent is a knowledge of molecular physics necessary to one who would teach theoretical chemistry?

In the Section of Mechanical Science Prof. Webb delivered an address on the second law of thermo-dynamics. Mr. Wagner ted an elaborate paper on electric light tests, giving an account of his work in testing the efficiency of two electric-light plants. Prof. Cooley explained and illustrated a method of testing indicator-springs. Prof. Thurston's paper on cylinder condensation is described as being of great scientific and practical value.

In the Section of Geology and Geography the address was by Prof. Edward Orton, and the subject, Problems in the study of coal, with a sketch of recent progress in geology. There were, in all, twenty-seven papers in this Section, none being geographical. Stratigraphy received the lion's share of attention, the most important paper on this subject being one by Prof. Henry S. Williams.

The address to the Biological Section was by Dr. Wilder, on Educational Museums of Vertebrates.

The Section opened with two papers by Prof. L. E. Sturtevant as the result of observations and experiments at the New York agricultural experiment station. The first, on the hybridisation and cross-fertilisation of plants. In the second—"Germination Studies"—the author gives, as a result of many trials with commercial seeds of our common plants, that very extended series of trials must be made with each species in order to obtain the desired accuracy in results.

An interesting paper on the biological deductions from a comparative study of the influence of cocaine and atropine on the organs of circulation, by Dr. H. G. Beyer, U.S.N., was read before the Section.

"On the Brain and Auditory Organs of a Permian Theomorph Saurian" was the title of an interesting paper by Prof. E. D. Cope. The author called special attention to the morphology of the brain, the character of the cranial walls and the auditory apparatus.

The disputed qnestion of the bisexuality of the pond-scums (Zygnemaceæ) was discussed by Prof. C. E. Bessey, of the University of Nebraska, who concluded that these organisms do not possess true bisexuality.

"On the Process of Cross-fertilisation in *Campanula americana*" was the title of a paper presented by C. R. Barnes.

A paper on aquatic respiration in soft-shelled turtles (Aspidonectes and Amyda) was presented by Profs. Simon H. and S. Phelps Gage as a contribution to the physiology of respiration in vertebrates.

Prof. C. E. Bessey read a paper on the inflorescence of *Cuscuta glomerata*.

Prof. Gage addressed the Section (G) on Microscopy and Histology on the limitations and value of histological investigation, and Mr. Dall discoursed to the Anthropological Section on the native tribes of Alaska. The papers in this section were very numerous, many of great interest, and all naturally devoted to anthropological questions connected with the North American continent.

## NOTES

THE National Sanitary Congress commenced its autumn meeting at Leicester on Tuesday, when the president, Prof. De Chaumont, F.R.S., gave an address on the work of the Sanitary Institute.

THE portrait of the late George Bentham, subscribed for by several of his friends, has been presented to the Herbarium, Royal Gardens, Kew, on behalf of the subscribers, by Sir John Lubbock. The picture is a successful reproduction, by Miss Merrick, of the original in the possession of the Linnean Society.

WE regret to notice the death of M. Breton des Champs, one of the French Government engineers, a mathematician and scientific writer who played a prominent part in connection with the Newton forgeries. In combination with his friend Leverrier, M. Breton des Champs exploded these frauds, which were so disgraceful to the good name of the French Academy of Sciences. He discovered the books from which the so-called "forger with long ears" had copied the assumed letter sold to M. Chasles.

THE Essex Field Club will hold its sixth annual cryptogamic and botanic meeting in Epping Forest on Friday and Saturday, October 2 and 3. On the Saturday afternoon and evening there will be an exhibition of fungi and other plants, fresh and preserved, with micro-objects; and papers will be read by Dr. Wharton and Mr. Worthington Smith. The following botanists, among many others, are expected to be present, and will act as "referees" in various departments of plant-lore:—Prof. Boulger, Dr. Braithwaite, Dr. M. C. Cooke, Rev. J. M. Crombie, Rev. Canon Du-Port, Messrs. J. L. English, Henry Groves, F. J. Hanbury, E. M. Holmes, David Houston, A. Vaughan Jennings, Frederick Daley, W. W. Reeves, Worthington G. Smith, C. A. Wright, Dr. Spurrell, Dr. H. T. Wharton, &c. Those wishing to attend should communicate with the hon. secretary, Mr. W. Cole, Buckhurst Hill, Essex, who will forward programmes giving full particulars.

The Trustees of the Gilchrist Lectures Fund have arranged for courses of [illegible] lectures in each of five Lancashire towns—Blackburn, Lancaster, Chorley, Colne, and Padiham, and for similar courses in Greenock, Paisley, Stirling, Alloa, and Kilmarnock, all to be [illegible] during October and December. No lectures will be given during November in consequence of the General Election in that month. The lecturers entrusted with the work are Prof. R. S. Ball, Rev. W. H. Dallinger, Prof. W. C. Williamson, Dr. Andrew Wilson, and Mr. W. Lant Carpenter. Each course includes three lectures on biological and three on physical subjects, oxyhydrogen lantern illustrations being freely used, and in some cases experiments also. As usual the charge for admission will be one penny, and the largest available rooms are secured for the lectures, special measures being taken to insure the attendance of working men. There will probably be similar courses in [illegible] Midland towns in the spring.

We are informed that the vacant Chair of Physics and Engineering in University College, Bristol, has been filled by the appointment to the post of Prof. John Ryan, M.A., King's College, Cambridge, [illegible] London, and Member of the Institute of Mechanical Engineers. Dr. Ryan, who is a practical engineer, has hitherto held the appointment of Professor of Mechanics and Engineering in University College, Nottingham. At Bristol he succeeds Prof. Thompson, now Principal of the Finsbury Technical College, and Prof. Hele Shaw, recently appointed to the Professorship of Engineering in University College, Liverpool.

Mr. F. C. Lehmann, a German botanist, who [illegible] travelled for over ten years in Central and South America for the purposes of scientific research, has arrived [illegible] at Panama, from Europe, which he lately visited in order to arrange with other scientific colleagues [illegible] the [illegible] of his extensive collection of objects of natural history. Mr. Lehmann was about to proceed to the [illegible], where he intends to remain for several years, with his domicile at Popayan. He proposes the continuation of [illegible] the botanico-geographical [illegible] of the [illegible] of [illegible] America.

The [illegible] character of the following announcement, coming from the United States, will attract attention. We take it from *Science*:—"On account of the lack of funds necessary to maintain its activity, the Astronomical Observatory of Beloit College, Wisconsin (Prof. J. Tatlock, jun., director), has been closed."

The experiments for the [illegible] illumination of the Palais Royal are very successful. The number of incandescent lights used is 150. The Théâtre Français, Théâtre du Palais Royal, and Council of State have agreed to the deed of agreement signed by the shopkeepers, so that thousands of lamps will soon be in operation. But before taking a final decision, the subscribers are trying every description of incandescent lamp.

A series of science lectures has commenced [illegible] Victoria Hall, Waterloo Bridge Road, and promises [illegible] successful as any previous one. On September [illegible] Harrison, F.G.S., will lecture on "Stone Tools [illegible] who used them." On October 6, Mr. A. M. [illegible] on "Some Other Worlds." On October 13, Prof. [illegible] Seeley, F.R.S., will lecture on "Coal."

We learn from the *London and China Telegraph* [illegible] which Dr. Dudgeon of Peking has been engaged [illegible] ten years, has just been issued in eighteen Chinese [illegible] comprises a translation of Gray's "Anatomy" and [illegible] "Osteology." There are in addition two [illegible] comprising 600 cuts, which have occupied the [illegible] for two years and a half. The whole of these [illegible] made at the expense of the Chinese Foreign Office [illegible] work has been published in a series [illegible] Language College at Peking. It is proposed to [illegible] connection with this college a medical school and [illegible] provide proper practitioners for the service of the [illegible] and palace.

A report on carp-culture in China has been [illegible] Macgowan to the Carp-Culture Association of the [illegible] Pisciculture, it appears, was cultivated at a very early [illegible] being regarded as a branch of agriculture. The [illegible] fish, the most frequently reared by artificial means [illegible] nearly every species of *Cyprinidæ*, bream, tench, [illegible] fish, &c., is so raised. A treatise on fish-rearing [illegible] tributed to a Minister of the fifth century before [illegible] it appears to have been really written eight centuries [illegible] work says that of the five modes of rearing [illegible] most productive and valuable is fish-breeding. [illegible] for this purpose (it goes on) should be an acre [illegible] depth is usually less than eight feet), and [illegible] having eight inlets or bays, a yard below the [illegible] water, should be constructed in it; then twenty [illegible] four males, each three feet long, are to be deposited [illegible] ready in the month of March. Two months later a [illegible] be placed in the pond, two months later a couple, and [illegible] [illegible] period three more. By this time there will [illegible] The [illegible] are to prevent their being transformed [illegible] and flying away. The object of the inlets and bays [illegible] greater space for the fish in their stomach [illegible] more a fish travels the fatter and bigger he becomes. [illegible] Chinese author then makes the following calculation [illegible] following year the pond will be found to contain [illegible] 1 foot in length, 450,000 3 feet, 10,000 2 feet. [illegible] year 100,000 1 foot, 50,000 2 feet, 50,000 3 feet, and [illegible] 4 feet. A thousand of those that are 2 feet in length should [illegible] for replenishment, and all the rest be sent to market. [illegible] another year their number will exceed all calculation, [illegible] [illegible] to feeding, hence the value of carp culture. All [illegible] varieties, we are told, come from the black species. The [illegible] destined to become white change to silver or yellow, [illegible] others [illegible] then golden. Some of the [illegible] are so nearly transparent that their viscera are visible. [illegible] of the art of rearing them consists in affording the [illegible] shade and sunshine in the course of their growth, and in [illegible] their water, not more than half of which is to be removed [illegible] fourth day. In the earliest times the practice, which [illegible] to-day, was introduced of planting mulberries on the [illegible] which spindles were placed, the droppings from which fed [illegible] fish, while the [illegible] of the trees first nourished silkworms [illegible] then goats. These droppings are said to impart a [illegible] flavour to the fish.

A consignment of [illegible] has lately been despatched by the National Fish Culture Association to the [illegible]

Government as a slight recognition of the presentations of ova made by them to this country. There is a great dearth of flat fishes in the United States, and at the instigation of the Commissioners of Fish and Fisheries many attempts have been made to forward young specimens for propagation from England. Hitherto these efforts have not met with success, it being exceedingly difficult to transmit live soles, as they are less tenacious of life than their congeners. We hope that Prof. Baird, who has received notice of the despatch of this valuable gift, will not be again disappointed. The fish have been placed in charge of an experienced pisciculturist, who will accompany the s.s. *Republic*, by which vessel they have been sent, and who will bring back a number of American species with a view to acclimatising them in this country.

THE Royal Commissioners of the Colonial Exhibition, to be held next year at South Kensington, have issued circulars to the Governors of our Colonies requesting them to send the various species of fish indigenous to their respective countries for exhibition. Special preparations will be made at the close of October for receiving them. The arrangements will necessarily be of an elaborate nature, as the tanks will have to be constructed in such a manner as to provide for the exigencies of each species and the regulation of high and low temperatures according to the climatal necessities of the fish.

SPECIAL interest is just now centred at the Aquarium in the incubation of the ova of some of the dogfish which have recently spawned. The eggs, which resemble filbert nuts in shape, are to be seen in a special tank, which presents a sight of much edification. The formation of the fish inside the ova is plainly perceptible, every part of them being apparent. The fish in the Aquarium are now being fed at 6 o'clock, partly on a new dietary specially invented by Mr. W. Burgess, of Malvern Wells.

THE Marquis of Lorne has successfully planted some whitefish in a specially constructed lake on the Isle of Mull. The fish form part of those reared by the National Fish Culture Association this year. His Lordship reports that the fish are doing well.

AT a lecture delivered by Mr. W. Oldham Chambers, F.L.S., at the Hull Town Hall last week on fish culture, living specimens of the whitefish and other foreign species of fish were exhibited, and excited much interest amongst the audience.

A RECENT *Bulletin* of the United States Fish Commission contains the following interesting account of the destruction of young trout by mosquitoes: "In the middle or latter part of June, 1882, I was prospecting on the head-waters of the Tumichie Creek, in the Gunnison Valley, Colorado. About 9 o'clock in the morning I sat down in the shade of some willows that skirted a clear but shallow place in the creek. In a quiet part of the water where their movements were readily discernible, were some fresh-hatched brook or mountain trout, and circling about over the water was a small swarm of mosquitoes. The trout were very young, still having the pellucid sack puffing out from the region of the gills, with the rest of the body almost transparent when they would swim into a portion of the water that was lighted up by direct sunshine. Every few minutes these baby trout—for what purpose I do not know, unless to get the benefit of more air—would come to the surface of the water, so that the top of the head was level with the surface of the water. When this was the case a mosquito would light down and immediately transfix the trout by inserting its proboscis, or bill, into the brain of the fish, which seemed incapable of escaping. The mosquito would hold its victim [illegible] until it had extracted all the life juices, and when this [illegible] finished, and it would fly away, the dead trout would turn over on its back and float down the stream. I was so interested in this before unheard-of destruction of fish that I watched the depredations of these mosquitoes for more than half an hour, and in that time over twenty trout were sucked dry and their lifeless bodies sent floating away with the current. It was the only occasion when I was ever witness to the fact, and I have been unable by inquiry to ascertain if others have observed a similar destruction of fish. I am sure the fish were trout, as the locality was quite near the snow line, and the water was very cold, and no other fish were in the stream at that altitude. From this observation I am satisfied that great numbers of trout, and perhaps infant fish of other varieties in clear waters, must come to their death in this way; and if the fact has not been heretofore recorded it is important to those interested in fish-culture."

A TELEGRAM from Rome, September 21, states that repeated shocks of earthquake have occurred in Benevento. The inhabitants are terror-stricken, and are encamped in the open country.

THE Russian *Official Messenger* states that the city of Namangan, in Ferghana, has been visited all through the summer by repeated shocks of earthquake, which have hitherto been of very rare occurrence there. The strongest shocks took place on April 17 and August 4, but no very serious consequences resulted.

ON September 12, at 9.30 p.m., a magnificent meteor passed over the city of Stockholm, going from south to north. Its light was very brilliant. On account of the limited area of observation it was impossible to tell whether it burst near the city or not.

DURING the month of August enormous swarms of ants passed over the town of Solothurn in Switzerland. They came from the Jura mountains, and formed a cloud, consisting of seventy-five perpendicular columns, in which the ants circled around in spiral form. The swarm lasted for twenty minutes, the height of the cloud being upwards of ninety feet. Millions of them fell to the ground, however, without making any visible change in the phenomenon.

ACCORDING to the *Bergen Adresseblad*, fishermen at the island of Mogster, on the coast of the province of Bergen, on the west coast of Norway, have lately seen large floating blocks of ice at sea, which are believed to be parts broken off from icebergs in the North Atlantic. Such a phenomenon has never before been observed in these parts.

THE Swedish journal *Norrbottens Kuriren* states that the water is falling rapidly in the Gulf of Bothnia, a phenomenon to which we have on several occasions referred. As a further proof of this the journal states that a stone in the archipelago by the coast which fifty years ago at lowest tide was barely visible above water is now at mean tide three feet above it.

WE have pleasure in noticing the issue of No. 43 of the first part and Nos. 29-31 of the second part of the well-known "Encyklopædie der Naturwissenschaften" from the house of Eduard Trewendt, Breslau. The former brings forward Dr. A. Reichenow's "Handworterbuch der Zoologie, Anthropologie, und Ethnologie," from article "Heteronereis" to "Icteridæ." Among other articles embraced within this interval are valuable contributions on the development of the organs of hearing by Prof. Griesbach; on "Hypnotismus," by Prof. Gustav Jager; on "Janaten," "Japauer," "Javanen," by Dr. von Hellwald; on "Hissarlik," "Hohlefels," "Hohlkeit," by Prof. Mehlis. Nos. 29 and 31 of the second part, again, continue the "Handworterbuch der Chemie," while the 30th number continues the "Handworterbuch der Mineralogie, Geologie, und Paläontologie." The two chemical numbers treat with all the fullness and thoroughness characteristic of this estimable work "Dichte," "Didym," "Diffusion," "Dinte," "Diphenylverbindungen," "Dissociation," "Dünger," and "Eisen," and the accompanying woodcuts illustrating any difficult experiments in the text add materially to the practical value of the articles. The new number, finally, of the Mineralogical, Geological, and Palæontological Dictionary contains important contributions on "Reptilien" and "Rhizopoden," by Rolle; on "Salze," by Kenngott; on "Schichtenlehre" and "Schwankungen im Niveau vom Meer und Festlande," by von Lasaulx—articles distinguished not more by fullness and compactness of matter than by clearness of dan. ne

WITH unflagging vigour and learning the new Italian quarterly, *La Nuova Scienza*, prosecutes the mission it has undertaken of building up an exact philosophy on the foundation of the natural and historical sciences. In the last number for June, 1885, the articles of chief interest, all contributed by the indefatigable editor, Prof. Enrico Caporali, are: Modern Italian thought, German anticlerical evolution, and the Pithagoric formula in cosmical evolution. The last-mentioned paper deals with the evolution of gravitation, of heat, of electricity, chemical affinity, lower organic force, higher organic force, sentient force, social authority; fatalist and free evolution. It is held in general that all evolution is due more to internal energy than to outward conditions, in opposition to Herbert Spencer's theory of mechanical causes.

THE address of Mr. W. H. Dall, vice-president to the Anthropological Section of the American Association for the Advancement of Science at Ann Arbor, last month, has been printed as a separate pamphlet. The subject of the address was "The Native Tribes of Alaska."

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. A. Cornet; a Red Kangaroo (*Macropus rufus* ♀) from Australia, presented by Mr. G. Wylie; a Bonelli's Eagle (*Nisaetus fasciatus*) from North Africa, presented by Capt. W. R. Taylor, s.s. *Empusa*; two Tawny Owls (*Syrnium aluco*), European, presented by Mr. H. Lee; a Nightjar (*Caprimulgus europæus*), European, presented by Mr. Cuthbeth Johnson; a Robben Island Snake (*Coronella phocarum*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; seven Blue-bearded Jays (*Cyanocorax cyanopogon*) from Para, purchased; a Beisa Antelope (*Oryx beisa* ♀), born in the Gardens.

## *ASTRONOMICAL PHENOMENA FOR THE WEEK*, 1885, *SEPTEMBER* 27 *TO OCTOBER* 3

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on Sept.* 27

Sun rises, 5h. 56m.; souths, 11h. 50m. 51·3s.; sets, 17h. 46m.; decl. on meridian, 1° 48′ S.: Sidereal Time at Sunset, 18h. 13m.

Moon (three days after Full) rises, 19h. 0m.*; souths, 2h. 1m.; sets, 9h. 13m.; decl. on meridian, 10° 42′ N.

| Planet | Rises | Souths | Sets | Decl. on meridian |
|---|---|---|---|---|
| | h. m. | h. m. | h. m. | ° ′ |
| Mercury | 4 29 | 11 1 | 17 33 | 5 36 N. |
| Venus | 9 34 | 14 12 | 18 50 | 16 17 S. |
| Mars | 0 19 | 8 11 | 16 3 | 19 47 N. |
| Jupiter | 4 33 | 11 1 | 17 29 | 4 46 N. |
| Saturn | 22 1* | 6 9 | 14 17 | 22 19 N. |

* Indicates that the rising is that of the preceding day.

*Occultations of Stars by the Moon*

| Sept. | Star | Mag. | Disap. | Reap. | Corresponding angles from vertex to right for inverted image | |
|---|---|---|---|---|---|---|
| | | | h. m. | h. m. | ° | ° |
| 28 | 48 Tauri | 6 | 21 56 | 22 45 | 33 | 273 |
| 28 | γ Tauri | 4 | 23 46 | 0 43† | 36 | 279 |
| 29 | 75 Tauri | 6 | 4 41 | 5 41 | 149 | 268 |
| 29 | θ¹ Tauri | 4½ | 4 48 | 5 26 | 54 | [illegible] |
| 29 | B.A.C. 1391 | 5 | 5 41 | 6 51 | 109 | [illegible] |
| 30 | 111 Tauri | 5½ | 3 2 | 4 17 | 73 | [illegible] |
| 30 | 117 Tauri | 6 | 5 15 | 6 5 | 53 | [illegible] |
| Oct. | | | | | | |
| 2 | λ Geminorum | 3½ | 0 38 | 1 32 | 30 | |

† Occurs on the following day.

The Occultations of Stars are such as are visible at Greenwich

| Sept. | h. | |
|---|---|---|
| 27 | 9 | Mercury in conjunction with and north of Jupiter. |
| Oct. | | |
| 1 | 11 | Saturn in conjunction with and 4° of the Moon. |
| 3 | 19 | Mars in conjunction with and 5° of the Moon. |

## *THE ASTRONOMICAL ASSOCIAT*

THE Astronomical Association held their eleventh
ing this year at Geneva from Aug. 19 to 22 incl
representatives of so many nations were present th
fully bore out the character of an international
the fifty members, or thereabouts, attending w
from Pulkowa; Newcomb, from Washingt
from Greenwich; Dunér, from Lund; Pechule
hagen; Tietjen, from Berlin; Krüger, from Kie
Strassburg; Tisserand, from Paris; Spörer,
The office-bearers were: Auwers, from Be
Schönfeld, from Bonn, and Seeliger, from Mun
Bruns, from Leipzig, Treasurer: while B
Leiden, Gyldén, from Stockholm, and Weiss, fr
honorary members of the Committee. Prof.
was also a member of the Committee,
attend.

The first sitting was opened by President A
of the University at 10 in the foreno
Among the scientific reports of the Committe
nications of Prof. Weiss on the present state
of the orbits of the comets were of sp
the 12 periodical comets returned at diffe
perihelion, 8 had again been regularly dete
calculators. Of the remaining four three we
present care: Biela's, which, as was know
observation, and the comets of Halley and
next perihelion lay too remote in the future
quently, but one periodical comet—Brors
count of. As to the remaining non-retu
168 which had appeared in this centu
garded as settled, 23 had their orbits p
in the case of 58 comets a new calcula
desirable for various reasons, and in all
culated definitely. There was, therefore
open. Prof. Weiss accordingly sough
Society the establishment of a common
the settlement of the questions at issue,
treatment of a particular comet should
left to the initiative of a single calculator.
ing this address, Staatsrath Struve arg
of such a bureau on the ground tha
peculiar a nature to accommodate the
treatment of a cal ulation bureau. N
the question.

This report was followed by com
character on the great zone undertak
communications were of no great ex
already in near prospect of complet
vey of the heavens by Prof. Pickerin
by Prof. Auwers, was heard with s
Next followed the scientific addre

in the Austrian Triangulation, communicated a table calculated by him, which would shortly be published, a table which materially lightened the approximate calculation of an eclipse for a particular spot on the surface, according to Oppolzer's elements.

Prof. Weiss then communicated the publication of the second volume of the *Annals* of the Vienna Observatory, and followed this up with the remark that the meridian circle, which was sixty years old, was now very much in need of repair; but, unfortunately, there was no money at disposal for this purpose.

After the President had opened the second sitting at ten o'clock on August 20, he communicated a report on the photographic mapping of all the stars of the "Bonner-Durchmusterung" which Gill (of the Cape Observatory) had begun, and of which about 100 plates were already to hand. The time taken for the exposure of each plate amounted on an average to one hour.

After various deliberations of a more private character the discussion turned on Resolution VI. of the Meridian Conference of Washington. The President declared emphatically that the question could be considered in this assembly only from an astronomical standpoint. The question was simply whether it were desirable for the astronomer to transfer the beginning of the day to midnight, and to this question the discussion should be restricted. At the outset the President announced that the Committee of the Society, with the exception of one member not present (Oppolzer)—that is, in the proportion of seven to one—had voted against the adoption of the proposal.

Staatsrath Struve (from Pulkowa) at once opposed the restriction advanced by the President, which, he thought, involved a one-sided treatment of the matter. It was to their advantage, he asserted, not to seclude themselves from the rest of the world. Magnetic and meteorological observers, he said, counted their day from midnight. Many astronomers, moreover, he continued, worked by day, and most observations were made between six and twelve in the evening. The change was defended by men eminent in science. The reform assuredly met a deeply-felt want. The question was "Should they make this sacrifice or not?"

Prof. Spörer, of Potsdam, mentioned that he always counted his observations from midnight.

Prof. Newcomb, of Washington, spoke at considerable length on the question, and rather against than in favour of the adoption of the proposal of universal time.

Prof. Weiss, of Vienna, was of opinion that the sacrifices demanded of astronomers by this reform were too great, and that the advantages were more than counterbalanced by the disadvantages. He laid stress on the fact that astronomers were wont to make their calculation of time from the moment when the time-determining object—the spring point—the mean sun—passed the meridian. That was also the true point of commencement. The observations which were of interest to the public at large, might be given in universal time, whereas with their more esoteric observations they might adhere to the old reckoning. The astronomer should keep by himself, and pay no attention to claims of intercourse.

Prof. Safarik, of Prague, said, "Why should we make a sacrifice on behalf of the public that feels no concern with our labours?"

Prof. Kruger, of Kiel, thought that altogether there were but few necessary points of relation between the astronomer and the public—points, however, which could be readily taken account of if the public desired it.

Dr. Dunér, from Lund, argued that by a change of date it would be impossible not to make a sudden break in astronomical labours that had hitherto been carried on uninterruptedly, to whatever time of day or night the commencement of the day was transferred. He concluded by expressing his opinion that the sacrifices demanded were too great.

Geheimrath Auwers expressed himself as personally opposed to the change, principally in order to avoid a discontinuity in the calculation of time which might, later on especially, lead to sensible errors.

Prof. Bakhuyzen, of Leiden, was refused a hearing, because he wanted to speak of seamen, who have the reform specially at heart.

Staatsrath Struve remonstrated against this proceeding, and argued that the question ought not to be treated onesidedly. At the Washington Conference seamen had the majority of representation, and opinion had there been almost unanimously expressed in favour of the reform. He was swayed by the desire of rendering astronomy useful to the rest of the world.

Prof. Gyldén, of Stockholm, argued that the change must give rise to vexatious errors unless it were universally carried out on one line. As the realisation of this idea was, however, more than could be looked for at present, he would now have to vote against the universal time. He believed, nevertheless, that in twenty or thirty years hence the majority of astronomers would be in favour of the universal time.

Prof. Tietjen, of Berlin, thought that in the Berlin Year-Book at all events, no such change would find place before 1900.

Staatsrath Struve maintained that in the Royal Astronomical Society the majority were in favour of the universal time.

Dr. Pechule, of Copenhagen, was also of opinion that it would be well for astronomy to accommodate itself to the rest of the world; but only when all were of one mind should the innovation be simultaneously and universally introduced.

Prof. Folie, of Brussels, thought that in all reforms there were some stragglers, and in his opinion it was the duty of astronomers energetically to take the initiative in the good cause.

After some recapitulatory observations of the President the discussion closed. No resolution whatever was passed on the subject.

It may be worth while mentioning here in respect of this subject that in the reading of the protocol it was affirmed that all the members of the Committee who were present were opposed to the adoption of the universal time. Objecting to this declaration, Dr. Pechule stated that Prof. Gyldén had only voted against the *immediate* adoption, while he entirely approved the *principle* of the proposed reform. The protocol had accordingly to be altered so as to give effect to this statement.

The series of scientific addresses was resumed by Dr. Mittag-Leffler, from Stockholm, who communicated the mathematical prize exercises which, under the auspices of King Oscar II., had been instituted by a special Commission.

Staatsrath Struve handed, for circulation, photographs of the great refractor of 30 inches aperture, which a short time ago had been mounted in Pulkowa, and expressed his complete satisfaction with the result.

Prof. Newcomb had thoroughly studied the instrument for seven days continuously, and corroborated Staatsrath Struve's views regarding the value of the instrument, entering into various details on the matter.

Prof. Tisserand, of Paris, spoke of a purely theoretical examination of the rotation of the earth.

Dr. Steinheil spoke on the calculations of Galileo's telescopes of new construction.

Prof. Spörer, of Potsdam, gave a somewhat long address on the new views regarding the physics of the sun.

The following day was devoted to a common trip around the Lake of Geneva, Col. Emile Gautier, at present Director of the Geneva Observatory, engaging at his own cost the saloon steamship *Winkelried* for this purpose. The dinner, which was served on board ship, gave opportunity for expressing the warmly-felt thanks of so many guests to their generous host for the entertainment he had provided them during the continuance of the Congress.

On the last day of the meeting, Saturday, August 22, the proceedings of a business character were brought to a close. The statutory order respecting the raising of the fee for life membership to 185 marks was adopted. As the place of meeting for 1887, Kiel was fixed on. The new election of a committee made no change in its former composition.

The scientific addresses were opened by Prof. Gyldén, who spoke of a graphic representation of planetary orbits.

Prof. Newcomb followed with an address on perturbations and their numerical calculation.

Prof. Bakhuyzen made communications respecting his treatment of Schröter's observations of Mars. He came to the conclusion that since Schroter's time "Huggin's Inlet" had probably changed considerably, whereby the hypothesis that Mars is in large part covered with fluid received material support.

Dr. Müller, of Potsdam, spoke on modern photometric apparatuses, and examined in particular those of Zöllner, Pickering, and Pritchard, entering into a searching criticism of them. The sources of error of the most considerable systematic deviations in the results obtained with these instruments were not yet sufficiently known, and it would therefore be well to mark out a number of stars of which thorough observations should be taken by the different observers with the use of all the three instruments.

Prof. Seeliger, of Munich, spoke of theoretical, and in part also practical, investigations he had commenced, which for the present had shown that the Lambert law respecting the reflection power of illumined surfaces, the basis hitherto of all photometric experiments, was entirely false. He reserved his more complete exposition of the matter till the close of his labours in this direction.

Prof. Safarik observed that some astronomers to whom he had communicated [illegible] plates, whose intermediate [illegible] of eye-pieces annulled the secondary spectrum, had given him a favourable report regarding their use. He was always ready, he said, to place other plates at the disposal of any who desired them.

Prof. Weiss announced that he was engaged in the preparation of a catalogue of 4500 stars which had formerly been observed at Geneva, a catalogue which was now approaching its completion.

President Auwers [illegible] expressed thanks for the friendly reception the Association had met with at Geneva and proposed to the meeting that they should rise from their seats in honour of Col. Gautier. The proceedings were then declared to be concluded.

## EDUCATION IN THE UNITED STATES

THE pride taken in popular education in the United States makes any digest of their experience valuable, and [illegible] carried on in their cities, the subject of a recent [illegible] of information from the Bureau of Education, is necessarily the branch of it most interesting in our crowded islands. Dr. Philbrick, the writer of it, has been, in Boston, a most successful school superintendent, an officer who undertakes the [illegible] duties of both School Board and Government Inspector, and one without whose services cities are here said to be behind the times. The uncertainty of a good choice of members for a School Board by popular election in the United States makes this office the more important, women having, as a rule, [illegible] [illegible] to counteract corrupt votes by their own. Every branch of education is treated upon here. Technical instruction, both as provided in [illegible] and in the United States, is largely and systematically considered; from the shape it takes in the school, where it simply [illegible] the gymnasium to [illegible] over thirteen years of age, to the apprentice school which really attempts to supersede the [illegible] system from which it gets its name by a more scientific and intelligent teaching of a few trades, among which building in its various branches, necessarily so important in a new country, is always one chosen. School museums are [illegible] commended, both of natural history and of technology; the [illegible] of school-rooms with statuary, &c., [illegible] provided for the purpose at low prices, a list of which is appended. The [illegible] [illegible] of [illegible] are a digest of [illegible] [illegible] and American experience, valuable to every one concerned with the architecture of schools of any class; and we may just note [illegible] that increased centralisation and [illegible] [illegible] are [illegible] that [illegible] French or German [illegible] [illegible] of secondary scholars; and [illegible] unnecessary [illegible] per cent. of [illegible] [illegible] for girls. "Free and [illegible] high school education is [illegible] Dr. Philbrick's ideal. He believes that the work of [illegible] elementary schools can be so revised that the higher [illegible] will be a simple continuation of the lower; so that a complete elementary course shall be just the same as the first few years of a university education. Higher stages are never to be commenced till after the age of fourteen. Free high schools, "the [illegible] [illegible] of all our institutions," are being used by youths who go back to farm work, contending that in no way [illegible] a classical education unfit a man for manual labour and [illegible] meetings of [illegible] boys, whose common interest in [illegible] the school helps to obliterate social distinctions. Such schools are to be provided for the mechanic to carry on his studies therein in the evening; while for higher students manual labour, especially the use of carpenters' tools, is to replace the gymnasium, and be pursued afterwards in evening technical schools; and thus study and labour will complement each other, [illegible] daily toil of the poor man is raised to the level of the [illegible] recreation. Military and fire drill are to be taught, and [illegible] out-door games. We fear that an elementary course [illegible] in itself and different from university rudiments, although [illegible] petuating class distinctions, will probably be a necessary [illegible] some time yet, and also that paralysis for lack of [illegible] must be incurred where pupils are required to attend the [illegible] in their own district of their own city—thus necessitating [illegible] formity of books for the sake of families removing.

## A PREHISTORIC CEMETERY

A DUNFERMLINE correspondent writes that another [illegible] tery of prehistoric times has been discovered on the [illegible] Pitreavie. About two and a half miles to the north-east of [illegible] former discovery a number of workmen were, some [illegible] engaged in collecting rough stones to form an [illegible] Ere the work had proceeded far it was noticed that the [illegible] which lay on a moor, formed a circle, partly covering a [illegible] 200 feet in diameter. In the centre of the mound, and [illegible] 36 inches below the surface, a cyst measuring 46 inches [illegible] and 24 inches in width was found. The cyst was [illegible] filled with a dark mould, and in it was discovered a [illegible] formed urn which stands 5 inches in height and [illegible] across the mouth. There was nothing in the urn but [illegible] in the cyst some large calcined bones were found. [illegible] tions were continued in the vicinity of the cyst and [illegible] stone circle, with the result that no fewer than [illegible] urns were found. All these urns contained calcined [illegible] bones and much vegetable charcoal, both in dust and [illegible] and numerous pieces of burnt bones were also found [illegible] mound—a circumstance which indicates that a good [illegible] terments had taken place without urns. The urns [illegible] from 5 to 12 inches in height, are hand-made, and [illegible] usually known as "food-vessels." They have [illegible] [illegible] ornamented with varied designs, formed by oblique [illegible] [illegible] on the upper part, and encircling projecting [illegible] bulged part. The urns are of a reddish colour, but the [illegible] section shows a black interior with a mixture of [illegible] There are several interesting features attached to the [illegible] In the first cemetery a row of cysts with an urn in [illegible] discovered [illegible] circumstances which unmistakably indicate the [illegible] dominance of inhumation over that of cremation. No [illegible] were found in the urns. In the second discovery only [illegible] was found, and eleven of the urns were simply buried [illegible] mounds, and all contained burnt bones—facts [illegible] cremation. The second discovery corresponds more [illegible] first with most of the prehistoric local cemeteries which [illegible] been laid bare in the county of Fife. The chronological [illegible] tionship between the two kinds of interment—[illegible] cremation—as presented to us in the two Pitreavie [illegible] opens up a most interesting field of inquiry to the [illegible] archæologist. Dr. Worsaae, the late distinguished archæologist, says cremation was the outcome of higher and more [illegible] religious principles than characterised the people of the [illegible] Age who were in the habit of burying their dead in [illegible] and other megalithic tombs, with food-vessels, weapons, [illegible] [illegible] and such articles as were supposed to be serviceable beyond the grave. Founding upon Dr. Worsaae's idea, [illegible] unreasonable to assume that the two discoveries [illegible] belong to the Stone and Bronze ages. The urns are all [illegible] hands of the proprietor of the estate, Mr. Beveridge, and [illegible] likely to be handed over to the National Society of [illegible]

## SCIENTIFIC SERIALS

*Annalen der Physik und Chemie*, No. 8, July 15.—This [illegible] tains the following:—On the time-relations of the [illegible] the electric residuum in paraffin, by C. Dieterici.—On [illegible] quantity of electrical elementary particles, by E. [illegible] the theory of thermo-electric forces, by the same.—On [illegible] tion from the laws of electro-dynamic points, [illegible] [illegible], by the same.—On some applications of theory of [illegible] of form in a body when it is magnetically or dielectrically [illegible] [illegible], by G. Kirchhoff.—Determination of some [illegible] friction and experiments on the influence of magnetism [illegible] electrification on the friction of liquids. The value [illegible]

## ... ACADEMIES

BERLIN

**Physiological Society.**

the pigmentary fold and a network of fibres, the ligamentum pectinatum iridis, which Dr. Virchow had searchingly investigated in a large number of animals. This network of fibres was so little developed in man as hardly to merit any consideration there. In other classes of animals, however, it attained a very remarkable development. The speaker gave a more detailed description of the course of the fibrous lines of the network, which presented a great multiplicity in the different animals. The fibres separated by larger interstices now pursued a principally posterior direction, now spread radiating from their place of origin at the union of the sclerotic and cornea, now they were developed more anteriorly, reaching far into the iris. By means of numerous diagrams and several preparations these anatomical relations were illustrated in greater detail. In regard to the physiological significance of this network of fibres the speaker was of opinion that they performed a mechanical function, but he dissented from the assumption put forth by some authors that the ligamentum pectinatum was the tendon of the ciliary muscle. Such an assumption was at variance with the fact that in the case of man, whose eye possessed powerful ciliary muscles, the ligamentum pectinatum was but weakly developed, whereas in other animals with a very weak ciliary muscle it was strongly developed. The fibres of the ligamentum pectinatum might operate as antagonists to the ciliary muscles in those cases in which they were especially directed posteriorly. In such cases, on the other hand, in which the fibres were developed more to the anterior side and passed into the iris, they would probably serve as antagonists to the musculus sphincter pupillæ. It was still more probable that by their radiation towards the membrana [illegible] they afforded support and hold to the fibres of the ligamentum suspensorium of the lens, establishing themselves at the other side of this membrane. This relation was to sight very close, by the course of the fibres, particularly in the case of the anthropoids.—Herr Aronsohn made some additions to his former communications on the physiology of the sense of smell. The most minimal quantities of clove oil and [illegible], which dissolved in 0·6 per cent. of common salt solutions, he was yet able to smell distinctly, tallied very well with the most minute quantities which Valentin had found perceptible by the sense of smell in the air. By electrical stimulation of the olfactory nerve he had also been able to call forth distinct sensations of smell in some other trustworthy persons. The physiological common salt solution of the temperature of 40° C. he had previously found to be entirely indifferent to the olfactory nerves. Were a part of the common salt replaced by other salts, then, according to the nature of the salt, different, mostly somewhat large, quantities of the salt (isotonic equivalents) had to be taken in order to form an indifferent solution. These isotonic equivalents Herr Aronsohn had now exactly determined for a series of salts. Finally, in order to demonstrate that there were special fibres in the olfactories for special smells, he had belaboured his own sense of smell for a certain quality of smells, that, namely, of sulphuret of ammonium, and had convinced himself that, though, indeed, no longer able to perceive this smell, he was yet very well able to smell ethereal oils.—Dr. Benda spoke of a series of preparations of sensory and motory nerve-endings which he had exhibited in the Demonstrating Hall. They were prepared according to a new process recommended by Dr. Meys. The process consisted in adding arsenic acid to [illegible] of gold and potassium. By means of this reagent the nerve-endings were made very beautifully visible, but in this way the epithelia were destroyed, and in order to preserve these likewise, Dr. Benda had further added to the fluid either chromic acid or alcohol. The exhibited preparations showed very clearly that the medullary sensory nerves ended in Kuhne's terminal plates, besides which in one case a marrowless, and certainly sensory, nerve-fibre, ending in a bifurcated small stem, could be distinctly traced. Marrowless fibres ended in an umbellate form, each single fibre on the muscle passing into a button-like swelling. These fibres, Dr. Benda held to be motory. There were further shown the nerve endings in the papillæ of the tongue, in the Pacinian corpuscles, in the cornea, and in the skin of the [illegible].—Dr. Kossel spoke of some important chemical relations of the cell nucleus, of that constituent of it, namely, which morphologists denoted as chromatine, and chemists as nucleine. As products of decomposition of the nucleine he had formerly obtained three nitrogenous bases: xanthine, hypoxanthine, and guanine. Quite recently he had obtained, though, to be sure, only in very small quantities, from the nucleine, a fourth base, namely, adenine,

discovered by him some time ago in the [illegible]. After he had prepared 3 g. of this substance, he [illegible] nitrous acid, and received as a product of the [illegible] adenine, hypoxanthine. When he treated guanine [illegible] manner he received xanthine. It was therefore [illegible] first products of decomposition of the nucleine [illegible] guanine, and that from these, first hypoxanthine and [illegible] were formed. The chemical relations of these [illegible] best rendered evident by their chemical formulæ:—

| | | | |
|---|---|---|---|
| Adenine | $= C_5H_5N_5$ | Guanine | [illegible] |
| Hypoxanthine | $= C_5H_4N_4O$ | Xanthine | [illegible] |

All the four bases stood in intimate relation [illegible] CHN, which by the action of caustic alkali [illegible] from them in very large quantities, while other [illegible] bodies under similar treatment yielded very little [illegible] none at all. It was doubtless of great importance [illegible] stood in such intimate relation to cyanogen. [illegible] ever, the cyanogen bodies played in the cell [illegible] unknown.

VIENNA

**Imperial Academy of Sciences**, June 5.—[illegible] mination of the halogens of organic bodies, by E. [illegible] On the products of reduction of the [illegible] on azo-nitrolic acids, by T. V. Janovsky.—On [illegible] rock-crystal in the magnetic field, by F. Tumlirz.—[illegible] tribution of heat on the earth's surface, by [illegible] logical researches, by H. Zukal.—Ideas on the [illegible] therapeutics of cholera, by L. Kostner.—On the [illegible] elements of the Alcyonidæ and Holothuridæ and [illegible] forms, by Ph. Pocta.—On the temperature of the [illegible] regions, by T. Hann.—Determination of the [illegible] Comet VIII. 1884, by S. Oppenheim.

June 11.—On the behaviour of liquid and [illegible] under the greatest variations of atmospheric [illegible] Puschl.—On the electrical resistance of copper [illegible] temperature, by S. Wroblewski.—On the formation [illegible] lution of white blood-corpuscles (a contribution to [illegible] leukæmia), by M. Loewit.—On the basalt of Kollnitz [illegible] Lavant valley, Carinthia), and on its vitreous [illegible] by K. Prohaska.—Report on the experiments [illegible] boiling oxygen, nitrogen, carbon oxide, and [illegible] refrigeratives, by K. Olszewski.—On the [illegible] acid at higher temperatures under the pressure of [illegible] K. Tavanowitch.

June 18.—Experiments on the chemical action of light [illegible] M. Eder.—On the volumetric determination of [illegible] [illegible], by K. Weinreb and C. Bondi.—On the [illegible] Tyroglyphidæ, by A. Nalepa.—On the decomposition [illegible] mium into its elements, by C. Auer von Welsbach.

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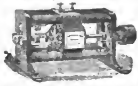

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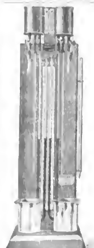

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## THE GARNER, OCTOBER, 1885.—Con-

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[illegible]

THURSDAY, OCTOBER 1, 1885

## *NORTH AMERICAN WATER-BIRDS*

*The Water-Birds of North America.* By S. F. Baird, T. M. Brewer, and R. Ridgway. Two Vols., 4to. (Boston: Little, Brown, and Co., 1884.)

EXPECTATION was roused some years since when tidings came that the "North American Birds" of Prof. Baird, Dr. Brewer, and Mr. Ridgway, of which three volumes had been brought out in 1874, was in process of completion, and at last there appeared two quartos of goodly size under the title of "The Water-Birds of North America," which are not only the sequel to the work just named, but are also issued in continuation of the publications of the Geological Survey of California, of which a single volume on the land-birds of that State, edited by Prof. Baird from the notes of Dr. J. G. Cooper, saw the light in 1870. But, to complicate the matter further, the two quartos now before us form vols. xii. and xiii. of the "Memoirs of the Museum of Comparative Zoology" at Harvard. How all this came about is explained in the introduction by Prof. Whitney, the Californian State Geologist; but the only part that need concern us is the not surprising but still much-to-be-regretted fact that the cost of bringing out the volumes treating of the land-birds of North America was so great as to deter the publishers from continuing the work at their own risk. Most fortunately, then, the combination just mentioned was effected with the result we now see; but it still remains a reproach and humiliation to those interested in birds—not only in North America alone but all the world over—that so excellent a performance was not more encouraged by them. The obstinacy of the public in preferring a bad book to a good one is perhaps observable in almost every science, but that this obstinacy is nowhere more marked than in the case of natural history, and of ornithology in particular may be because it is one of the most popular branches of science, and because nine-tenths of those who pursue it hardly realise the fact that it is capable of serious study. Howbeit we may be sure that the old adage, "*Populus vult decipi*," was not first uttered by a man without worldly knowledge, and to this day experience tells us that it is as true as ever. It will take a long time yet to persuade people that they had better be well informed by an author who writes a book because he knows his subject, than by a badly-informed one who gets up his subject in order to write a book about it—though even this is perhaps saying too much, for many an author, on ornithology at least, has never taken the trouble to learn the rudiments of what he pretends to teach, and if he have but enough self-assurance he will get his claim to instruct allowed by those who are more ignorant than he is.

To all who have been concerned in the production of the text of the two volumes before us we must offer our hearty congratulations, as it is impossible for us to apportion to each anything like his proper share of merit. Besides the naturalists already named, Prof. Whitney [illegible] in his introduction, that in revising the not wholly [illegible] manuscript he has had the assistance of Mr. [illegible] known as head of the ornithological department of the Harvard Museum, and that gentleman is therefore entitled to our thanks as much as any one of the others; but moreover it is also advisable to look back to the original preface of Prof. Baird, in which he states that "the most productive source" of the new information published in this work "has been the great amount of manuscript contained in the archives of the Smithsonian Institution in the form of correspondence, elaborate reports and the field-notes of collectors and travellers." The most important of these, he goes on to say, are those by the late Mr. Kennicott, and several residents in the then Hudson's Bay Company's Territory—Messrs. MacFarlane, Ross, Lawrence Clark, Strachan Jones, and others—besides Messrs. Dale, Bannister, and Henry Elliott in regard to Alaska and its islands. Now this being the case with respect to the former volume, which treated of the land-birds only, the importance of the labours of these gentlemen ought to be far more manifest in the present volumes, which deal with the water-birds, since an overwhelming majority of them have their home in the vast northern regions of the continent, and are only winter-visitants to most of the States and Territories of the Union. A good deal to our disappointment we find it otherwise. It may be that the late Dr. Brewer, who is believed to have been responsible for the "biographical" portion of these as of the former volumes, had not at his death completed the examination of the unpublished materials at his disposal; but certainly there is not so much information from American sources as we had hoped or even expected. On the other hand, European authors are freely, not to say redundantly, laid under contribution for such species as are common to the two continents, which it is needless to say are many. Of this we do not complain, though we confess we should rather have learned how these species behave themselves on the other side of the Atlantic; but there is a want of discrimination as to the opportunities possessed by the different observers quoted, and a lack of proportion as to the value of their observations. We do not say that this is not pardonable, perhaps it was unavoidable; but it is unfortunately no less a drawback; and, to make it worse, several instances might be cited in which absolutely contradictory assertions are reprinted without any attempt to indicate which is thought to be the more worthy of belief; while a good many of the statements to which this objection does not apply are but vain repetitions.

Passing to the descriptive part of the work, we do not hesitate to declare that, so far as we have been able to test it, it is excellent. The "specific characters" given seem really to deserve their name, since they indicate the species, and are not, as has lately become so common, drawn from an individual example. Moreover, they are sufficiently brief to be useful, for we have unfortunately entered upon days when specimens are described at a length that absolutely precludes the practical application of the description. Nothing marks more distinctly the difference between a naturalist and a book-maker than the being able to perceive and to tersely express the characters that are essential to the differentiation of a species. Among ornithologists, merely to cite the example of one who is gone, it seems to have been this faculty that gave the late Mr. Gould such a wonderful pre-eminence among his contemporaries. Others unquestionably far surpassed him as scientific ornithologists, indeed the scientific value of his works is very slight; but hardly any one had such an eye for a species, or could in a dozen words or so point out how it could be recognised. It is no doubt in consequence of this that so few of the species described by him have failed to be considered good by his successors.

The ornithologists of the New World are in one respect very fortunate. They are not encumbered by the enormous dead weight of synonomy that is so burdensome to their brethren of effete Europe; and, thanks to the steadfastness with which the North Americans follow the use of a nomenclature fixed by authority, they will probably be for ever exempt from much of the evil which afilicts the more independent writers of the Old World, almost each of whom likes to be a law unto himself. Whether the nomenclature now accepted in the United States and in Canada be founded on the best principle is a matter that need not be here discussed. It has been reduced to a practice the real advantage of which none can doubt. But that this state of things is possible arises in great measure from the fact that in one sense a very small number of North American birds have an ancient history such as is possessed by nearly all the European species, though of this ancient history the compilers of synonymy in general give but a feeble notion. Few things are more misleading than a long list of synonyms, such as is too often regarded as a test of an author's industry and knowledge. It almost always happens that in a list of this kind bad accounts and good are made to appear as though they stood, as it were, on an equal footing, and it not unfrequently occurs that a reference to the best account of a species may be wholly omitted, while a fantastic name introduced by some compiler or catalogue-maker, who perhaps never examined or even set eyes on a specimen, receives notice as if it were an important contribution to the history of the creature. If Americans suffered from this grievance to the same extent as Europeans do, we suspect that the ingenuity of the former would lead them to find some remedy for it, but they may bless their stars that they are comparatively free from it.

Every well-informed ornithologist knows that the systematic arrangement of birds presents a series of puzzles which as yet defy solution. Still, some steps towards the clearing away of the old trammels have been taken by various persons, and a few positions that may be looked upon as established have been gained. We are sorry to find so little in these volumes suggestive of further advance. The writers seem to be still enchained in the toils which the artificial system of Sundevall drew around the subject, and in the very brief space—barely two pages—thereto devoted, we have "altricial" and "præcocial," "gymnopædic," and "dasypædic" groups spoken of as if they were to be believed in. It is true that the arrangement adopted is said to be "not strictly natural;" but in the same paragraph are some other stateme[illegible] affinities or the reverse that we hope the autho[illegible] to repent. However we freely admit that the m[illegible] of these volumes is not to teach systematic or[illegible] and therefore perhaps the less said on that co[illegible] subject the better. They will, there can be no [illegible] admirably fulfill the chief purpose for which they intended, and enormously further the study of birds in English-speaking America. It would be out of place here to enter upon any minute criticism of their contents, and, while indicating in a general way, as we have attempted to do and as we conceive we are in duty bound, some of their shortcomings, we can strongly recommend them as on the whole justifying the high degree of expectation that had prevailed concerning them prior to their publication. Assuredly we shall have to wait long before another so comprehensive and, taking it all in all, so excellent an account of "The Water Birds of North America" is likely to make its appearance, and once more we tender our thanks to each and every one of those who have been concerned in the work, though we may perhaps make a reservation in regard to the wood-engraver.

## 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. No notice is taken of anonymous communications.*

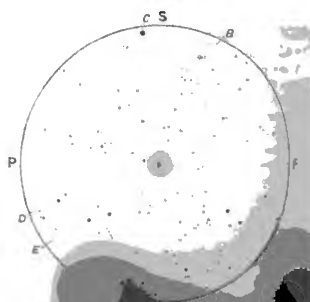
*[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*

### The New Star in Andromeda

The information furnished by a photograph of the Great Nebula in Andromeda taken last year may be of value, particularly in relation to the presumed variability of the new star. An examination shows that no star brighter than about the [illegible] magnitude was then in the position now occupied by the new star.

This photograph was a trial plate taken on August 16 between 10h. and 11h., with an exposure of 30 minutes of the [illegible] reflector. With this exposure the impression of the nebula [illegible]

**Fig. 1.**



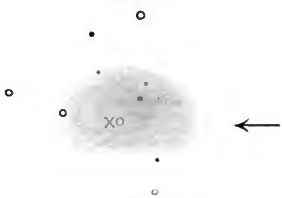

small for such a [illegible] in the [illegible] being limited to [illegible] around the [illegible] which was bright and [illegible] ph of the Cr[illegible] quent want of sharpness on one side, but the definition in the centre of the field is not injured.

To give some idea of the stars that can be seen and the value that may be given to photographic evidence of the existence or non-existence of faint stars, I give some particulars of this photograph. Without a magnifier 124 stars are to be seen within a radius of twenty minutes of arc from the nucleus.

I have traced these (see Fig. 1) so that they can be identified in the telescope; some of them may not be less than 13th magnitude, possibly fainter; the bright stars marked B, C, D, and E being shown in Argelander's maps of the Northern Heavens. B and C are at the present time about the same brightness as the new star, and can be well used to watch any variation in its light (when first seen by me on September 3 the new star was very much brighter than B or C, almost as bright as a star I have called A in my note-book that is just beyond the smaller nebula).

Using a magnifier to detect any fainter stars I find six near the nucleus: these I have shown as black dots on Fig. 2, using a circle to show the stars near the nucleus that appear on Fig. 1, and a cross (×) to indicate the place of the new star. At this particular place there is not the slightest indication of any difference in the regular shading of the deposited silver from the denser part of the nucleus to the faint edge. The six stars indicated are extremely faint in the photograph and difficult to see, but I have no doubt of their real existence; from a comparison with other photographs I estimate them of about 15th magnitude, perhaps fainter. It may be that some of these may be identified at Birr Castle. From the absence of scale and orientation of the sketch given by Lord Rosse on p. 465 comparisons cannot be made, but a reference to the note-books would enable this to be done. A. A. COMMON

FIG. 2.



Scale 0·4 inch = 100″.

DURING last week I examined on three evenings the spectrum of this star apparently in the nebula. It appears to be continuous, extending from about D, as far as, or perhaps a little past F. Both Mr. Percy Smith and I are able to confirm Lord Rosse's conviction of the existence of a bright line or band. We compared its position with spark spectra, and feel satisfied that its position is not far from the bright line of the spark in air near to, and on the more refrangible side of D. The slit was of course necessarily wide, and the spectrum faint, so that this must only be considered as approximate.

GEO. M. SEABROKE

Temple Observatory, Rugby, September 29

IN the first evenings of September I observed the new nucle[illegible] the nebula in Andromeda: I find it of the 8th mag[illegible] with a little Maclean's star spectroscope applied to the [illegible] the spectrum of the nucleus is continuous, with[illegible] bands. On the nights of Sept. 14 to 16, with[illegible] ments, I found to the east of the nucleus, [illegible] it, a faint object, probably a second [illegible] magnitudes. A. RICCO

[illegible]

### [illegible] Astronomical Day

[illegible] the recent meeting of [illegible] NATURE, vol. xxxii. [illegible] ted "that in the Royal Astronomical Society the majority were in favour of th univer al day." There appears to be some mistake here: the Royal Astronomical Society as a body has not expressed any opinion on the subject. And, judging from the individual expressions of opinion which have been published, I should imagine that here, as at Geneva, the majority of real workers in our science (with the probable exception of those engaged on solar work) would be opposed to the proposed change. But how the majority of the Fellows of the Royal Astronomical Society could vote on the question it is impossible to say. My desire that a wrong impression on this subject, arising from a statement reported to have been made by such a high authority as Dr. Struve, should not be spread abroad, must be my excuse for trespassing thus far on your space.

A. M. D. DOWNING

Royal Observatory, Greenwich, S.E., September 26

### A Tertiary Rainbow

PROF. TAIT remarks, in his recently-published work on "Light," that rainbows due to three or more internal reflections "are too feeble to be observed." It may therefore be worth recording that a tertiary bow was clearly visible from Thandiani Hill, Punjab, one evening last week (August 17). The bow extended over an arc greater than a semicircle, but was broken in two places. The colours were as distinct as in many an ordinary bow.

The condition of the sky was specially favourable for seeing a tertiary bow. The sun was low, and on nearly the same level with it there were several horizontal layers of cloud of considerable extent, whose nearer, unilluminated sides were therefore dark enough to serve as a good background for the bow. There was also a cloud in front of the sun itself, partially reducing its brightness. T. C. LEWIS

August 25

### A White Swallow

ON August 3 I saw a white swallow flying among its fellows over a mill-pond at Garioch's Ford, Auchterless, Aberdeenshire. When I repassed on the following day it was still there, and it appeared to my brother and to me to be *entirely* white: otherwise I should suggest that the one seen in Westmoreland on September 4 (NATURE, No. 830, p. 500) might be the same bird on its southward pilgrimage. If it is true that the albino bird is never courted or paired ("Descent of Man," chap. xiv.) we are not likely ever to see many white swallows.

Mirfield, Yorks, September 28 ALEX. ANDERSON

THE enclosed paragraph from Yarmouth, in the *Norfolk News* of this day, will have interest for your correspondent at Milnethorpe. HUBERT AIRY

Stoke House, Woodbridge, September 26

*Rara Avis.*—A cream-coloured specimen of the swallow (*Hirundo urbica*) was shot on Caister Road, on Monday morning last, by Mr. A. Patterson. It is now in the hands of Mr. B. Dye of Row 60 for preservation.

DURING the summer of 1883 Mr. Cooper, of Bromwich, observed a white swallow throughout the season at a place within the city on the banks of the Severn. J. LL. BOZWARD

Worcester, September 28

## *THE ANNUAL CONGRESS OF THE SANITARY INSTITUTE OF GREAT BRITAIN*

THE subjects dealt with by the Sanitary Institute of Great Britain at its annual meetings cover a wide field, and the Leicester gathering of this year, under the presidency of Prof. de Chaumont, F.R.S., forms no exception to the rule. The first aim of the Institute is, through its various agencies, to assist and indeed to lead in the improvement of public health, and the President did well to prove, by mortality statistics, how great a saving of life can be effected by the adoption of efficient sanitary measures, and how remunerative expenditure in this direction proves itself to be. The result of the sanitation carried out in the Army, and which is so much due to the labours of the late Dr. Parkes and to those of his successor, Dr. de Chaumont, is that, comparing the results of thirty years ago with those which now obtain, there is a saving in the home Army of two battalions per annum. Some substantial progress is also being made in the same direction as regards the general public, and when it is more fully understood that preventible diseases as a rule destroy those members of the population who are most remunerative in so far as the State is concerned, and that, speaking generally, each such premature death means a loss of at least 100*l*., even parsimonious members of sanitary authorities will not mind expending a little more of the public money in so good a cause.

Leicester was well chosen for this year's gathering, for in many respects the town has acquired some reputation in health matters. It may be regarded as the head-quarters of the anti-vaccination party; it prides itself, not without cause, on the efforts it has made to control the spread of infectious diseases; and it takes precedence amongst those English towns in which autumnal diarrhœa is so fatal to the infantile population. As regards the question of vaccination it would be premature to draw any general inferences from the Leicester results, for although during recent years only a comparatively small portion of the infantile population have been vaccinated, yet a vast majority of the inhabitants are fairly well protected against small-pox, and it is by no means so very strange that a disease which usually recurs in an epidemic form only after a lapse of years, should for a time remain absent from Leicester. Still, we frankly admit that the day of reckoning has been somewhat long in coming; but there are exceptional reasons for this. And in the first place we would note that Leicester is not so free from small-pox as is generally imagined. The Registrar-General's returns have, it is true, long shown an almost absolute blank as regards small-pox mortality there, but it must be remembered that the Leicester Small-pox Hospital, where the deaths from this disease take place, is not in the borough, and hence that the mortality occasioned is registered in altogether another district. Then again, the sanitary authority of Leicester, by the aid of a system of compulsory notification of infectious diseases, acquire the earliest knowledge as to the existence of cases of small-pox, and having provided themselves with an isolation hospital, the patients are at once removed, and their houses and clothing are efficiently disinfected. It may be said that any other town could do the same, and so vaccination would become unnecessary. But this is not so. Removal to hospital is only compulsory under conditions which, were objection raised to it by the people, would make this early isolation impracticable, and all populations are not so proud of their defiance of one of the laws of the country as to submit without resistance to the steps which are held necessary in order to prove that this law is a superfluous one. But Leicester goes much further than this. The authorities not only remove the sick, but they remove the healthy members of the sick person's family, and hold them in a species of quarantine until they know that they have escaped infection. Such a step may be very desirable from a health point of view, but it is altogether illegal, and it is quite certain that if any attempt were made to enforce such a system in oth[illegible] parts of the kingdom it would be resisted. The maj[illegible] of the nation would also hold it to be unnecessary; an[illegible] recent publication by the German Government o[illegible] Report of a Commission showing that [illegible]nce re-vaccina[illegible] was made compulsory in 1874 [illegible] death fr[illegible] small-pox has occurred in th[illegible] affords ample evidence that the simple op[illegible] [illegible]ation can fully meet all the difficulty.

But little further light was th[illegible] upon that obscure zymotic diarrhœa [illegible] so large a mortality in Leicester. B[illegible] has made the subject a special study, probably points out the essential cause of this fatality by showing how [illegible] large portion of the population of Leicester was expo[illegible] to the influence of a water-logged soil charged with de[illegible] composing organic matter. Temperature so lar[illegible] influences this mortality that it was at one time regar[illegible] as its sole cause; but it is certain that a high temper[illegible] alone is powerless to produce it, whereas the effec[illegible] temperature on such conditions as obtain in Leice[illegible] must be very potent in favouring the developmen[illegible] organic germs, such as are now supposed to lie at [illegible] root of the evil. Extensive inquiry is needed as to [illegible] subject, and we hope that the results of the investiga[illegible] which have been conducted for some years past by [illegible] Medical Department of the Local Government B[illegible] will soon be made public.

Amongst the many other matters of interest wh[illegible] were dealt with at the Congress is that of the prov[illegible] of dwelling-accommodation for the working classes, [illegible] in view of the steadily extending practice of massin[illegible] gether vast numbers of human beings in great build[illegible] where storey is piled upon storey, the warning uttere[illegible] Mr. Gordon Smith, President of the Engineering [illegible] Architectural Section, and the occupant of an impor[illegible] official appointment which adds weight to his op[illegible] should receive careful consideration. He asserts th[illegible] this class of buildings there has been an exce[illegible] infantile death-rate, and it is certain that the provis[illegible] ample open space about dwellings, which is, as reg[illegible] ordinary dwellings, being more insisted on than eve[illegible] especially necessary in the interests of child-life, wh[illegible] so extremely sensitive to such insanitary surroundin[illegible] influence the quality of the air breathed.

The question of a rational system of burial was [illegible]cussed at the last meeting of the Congress in conne[illegible] with a paper by the Rev. F. Lawrence, who quote[illegible] authority of the burial service of the Church of E[illegible] as suggesting a system which would allow of the [illegible] action of the soil upon the dead, and who adv[illegible] burial at a depth of three or four feet only [illegible] designed to ensure speedy perishability, and [illegible] at a depth of three or four feet only from the surfa[illegible] The advocates of cremation were naturally represe[illegible] but the progress of this method for the disposal [illegible] dead is hindered by considerations which it is not eas[illegible] overcome. Foremost amongst these stands the di[illegible] of tracing cases of poisoning, and, even if the public [illegible] ready to assent generally to post-mortem examina[illegible] before the cremation was carried into effect, no [illegible] examination as is usually carried out could be truste[illegible] decide whether this species of crime was the cause [illegible] death or not. Indeeed, in many cases of poisoning [illegible] most skilled pathological and chemical knowledge [illegible] required in order to avoid error. On the whole, [illegible] discussions as have taken place at Leicester tend [illegible] improvement in matters where change is desirable [illegible] interests of public health, and the Institute may be [illegible]gratulated on the results of their recent meeting.

## *INSECT RAVAGES*

THE preservation of our garde[illegible] field crops [illegible] the attacks of injurious an[illegible] [illegible]hich Miss E. A. Ormerod [illegible] [illegible]hich she has carried [illegible] Ormerod's labours in [illegible] within the know[illegible] [illegible] with agricultura[illegible] [illegible] need [illegible] [illegible] the [illegible] [illegible] the [illegible] [illegible] to be [illegible] prize offered by her at an agricultural show held at Frome last year, the result of which was satisfactory in drawing a considerable amount of attention to the subject, and one of the outcomes of which has been the preparation of a series of object lessons, so to speak, which have been elaborated from the plan of Mr. W. H. Haley, who took the prize at Frome last year. The plan of these lessons is as follows:—One insect is taken as an example and the life-history of this particular insect is illustrated by showing the creature in all its stages of development where practicable, or by neat and accurate-coloured drawings of pupa, larva, and perfect insect, each stage of which is carefully labelled, then a spray or twig of the plant attacked, or a model showing the insect's ravages is given, and in many cases also the parasites which attack the insect itself. Beneath this is carefully printed the life-history of the particular insect, and an enumeration of the plants upon which it feeds; and, finally, under the head of "Prevention and Remedies," some brief but concise instructions how to proceed to rid one's crops of the pest. All this is arranged on a cardboard mount 12 inches long by 8 inches wide, and placed in a box with a glass cover, so that one insect only is treated of in one case, thus making the information imparted very clear, and preventing all confusion. Of the insects treated in this way are the turnip and cabbage gall weevil, turnip moth, turnip fly, cabbage aphis, large white cabbage butterfly, cabbage moth, vine beetle, bean beetle, pea and bean weevil, winter moth, American blight on apple, magpie moth on gooseberry, celery-leaf miner, silver moth, beet or mangold fly, click beetle and wireworms, goat moth, lacky moth, daddy long-legs, and onion fly.

Twenty of these cases have recently been prepared by Mr. Mosley, of Huddersfield, under the superintendence of Miss Ormerod, and are now in the museum at Kew, and a set of ten of a similar character are to be placed in the Aldersey School of the Haberdashers' Company at Bunbury, Cheshire, where plain teaching on such subjects is being satisfactorily carried on. J. R. J.

## AMERICAN AGRICULTURAL GRASSES[1]

HOWEVER complicated the systematic synonymy of the Gramineæ may be, the popular nomenclature of the grasses is probably in an even more unsatisfactory state. In the former case the name of the author appended to the scientific name of the plant is usually sufficient to dispel any ambiguity as to what particular plant is meant, even though that plant may have received half a dozen systematic names from as many different botanists. In the case of the trivial name, however, even this means of identification is lacking, and it is no uncommon circumstance to find the same name applied to several different grasses, each one of which may, moreover, have one or two additional names. To those who are studying the grasses in their agricultural aspect this confusion is very perplexing, particularly as both the English and the American agricultural journals usually refer to a grass by its trivial name. The difficulties which surround this subject are well exemplified in the volume before us. For example, in American agricultural publications the term "salt-grass" is frequently met with, and w[illegible] searched this volume in the hope of finding out the [illegible]ies so denominated. But instead of one we find no [illegible]han four distinct species, in as many genera, called [illegible]rass," namely, *Vilfa depauperata*, *Sporobolus* [illegible] *Brizopyrum spicatum* (*Distichlis maritima*), [illegible]*ina juncea*. To an English agriculturist foxtail [illegible]*ecurus pratensis* only, whereas in America the name is also given to *A. geniculatus*, *Hordeum murinum*, *H. jubatum*, and *Setaria setosa*. Rye-grass in England is *Lolium perenne*; in America the term is applied in addition to four species of Elymus. Blue grass is the name given to four distinct species of Poa, varying considerably in their agricultural value, and one of these, *P. pratensis*, often spoken of as Kentucky blue-grass, is also called "June grass," "spear grass," and "red top," the last name being equally applied to *Agrostis vulgaris*. Bunch grass is more vague in its application, for it embraces at least six species in five genera, while in Canada the same name is given to two other grasses, *Elymus condensatus* and *Kœleria cristata*, the former of which is known in the United States as "giant rye grass." The term "goose grass," which in England is restricted to the rubiaceous hedgerow weed *Galium Aparine*, is, in America, applied to *Poa annua*, which is also called annual spear grass, and to *Panicum Texanum*, further known as Texas millet. The grass *Holcus lanatus*, which to all English farmers is known as Yorkshire fog, is variously termed velvet grass, velvet mesquite, satin grass, and meadow soft grass, this last term being also current in England.

There are about 600 species of grasses in the United States, a few only of these having been introduced. The work under notice embraces descriptions of 120 species, each accompanied by a plate. Of these, about forty, included under twenty-six genera, are identical with British species. Five additional British genera are represented, but not by British species; these are Elymus, Melica, Spartina, Stipa, Triodia. About a dozen British genera do not appear, the most noteworthy among these being, perhaps, Brachypodium, Briza, and Cynosurus. Two dozen of the genera enumerated are extra-British; the chief ones are Andropogon, Aristida, Bouteloua, Buchloë, Danthonia, Muhlenbergia, Paspalum, Sorghum, Sporobolus, and Zizania. The so-called buffalo grasses are *Bouteloua oligostachya*, *Stipa spartea*, and *Buchloë dactyloides*; the first two may be gathered in quantity by any one who travels across the Canadian prairies, but the last-named, which is regarded as the true buffalo grass, does not extend into Canada.

In upwards of 100 pages of text we find collected much information both of botanical and of agricultural interest. The structural and economic characters of each grass figured are detailed at some length, but Dr. Vasey has, perhaps wisely in a work of this kind, made no attempt at classification. Though systematic synonyms are seldom given, there is a lavish display of trivial ones, for which the agricultural reader, at all events, will be grateful. Orthographic blunders are rather numerous, and the index might be more complete. The term *chartaceous* ("the texture resembling paper or parchment in thickness") is, we believe, not current on this side of the Atlantic; let us hope we may do without it.

The chemical analyses are of much agricultural interest, and readers should compare the results here given with those obtained by Wolff in his analyses of German grasses. The figures before us serve to show how considerably the same gramineous species may vary in composition according to the soil and climate in which it is grown, this point being specially illustrated by analyses of *Phleum pratense* and *Dactylis glomerata*, each from half a dozen different localities. How variable is the composition of gramineous herbage generally is well shown in the following table, in which are given the highest and lowest percentages of the constituents named, obtained in 136 analyses of different species of grasses:—

| Dry substance | Highest | Lowest |
|---|---|---|
| Ash | 19·24 | 3·57 |
| Fat | 5·77 | 1·48 |
| Nitrogen free extract | 66·01 | 34·01 |
| Crude fibre | 37·72 | 17·68 |
| Albuminoids | 23·13 | 2·80 |

[1] [illegible]ural Grasses of the United States." By Dr. George [illegible]he Department of Agriculture; also, "The Chemical [illegible]ican Grasses," by Clifford Richardson, Assistant [illegible] Department of Agriculture, 1884.)

A process which has been the means of throwing much light on problems in vegetable physiology and agricultural chemistry, namely, a comparison of the analyses of a plant and of its separate members in different stages of growth, has been applied to fifteen familiar species of grasses, and the results are tabulated and briefly discussed.

Many useful suggestions, some of them of the highest practical importance, are to be met with in these pages. Here is one by Prof. Asa Gray which refers to the Teosinte, or Guatemala grass, *Euchlæna luxurians*, a native of Mexico and Central America, and has the true ring of progress about it:—

"To make the *Teosinte* a most useful plant in Texas and along our whole south-western border the one thing needful is to develop early-flowering varieties, so as to get seed before frost. And this could be done without doubt if some one in Texas or Florida would set about it. What it has taken ages to do in the case of Indian corn, in an unconscious way, might be mainly done in a human lifetime by rightly directed care and vigorous selection."

This volume is highly creditable to its authors, and it adds one more to the many useful publications which have emanated from the United States Department of Agriculture. W. FREAM

## THE DEVELOPMENT OF THE CÆCILIANS

IN a letter recently published in the *Arbeiten aus dem zoologisch-zootomischen Institut in Würzburg*, Messrs. P. B. and C. F. Sarasin give a preliminary account of the development of *Epicrium glutinosum* as observed at Peradenia in Ceylon, where these naturalists have taken up their quarters near the celebrated Botanical Gardens. Since the original discovery by Johannes Muller of the larval form of the Cæcilians, almost the only information obtained on this important subject is a short account of the gilled larvæ of *Cæcilia compressicauda* by Peters, founded on specimens procured by Jelski in Cayenne.

The brothers Sarasin show that *Epicrium* is not viviparous, as is *Cæcilia*, but oviparous. In the most advanced stage before hatching the embryo is provided with very long blood-red external gill-filaments, and has also a distinct tail with a strong fin. The gill-filaments are shed previous to the hatching, after which the young Cæcilians make their way to the neighbouring stream, and live in the water, breathing by means of gill slits. After they leave the water their gill-slits close up, and they breathe by lungs. The brothers Sarasin compare these Cæcilians to Urodeles, in that they pass through the perennibranchiate stage in the egg. As larvæ they are derotrematous, and in the adult stage become true land-animals like Salamanders. Our authors also show that the spermatozoon has a spiral filament, and that there is a fourth gill-arch, from which the pulmonary artery is given off. Both these facts tend to show that the Cæcilians are more nearly allied to the Urodeles than to the Anurous Amphibians.

## THE BRITISH ASSOCIATION

### REPORTS

*First Report of the Committee, consisting of Mr. [illegible], Mr. Thomas Gray, and Prof. John Milne (Secretary), [illegible] for the purpose of investigating the Earthquake Phe[illegible] Japan.* (Drawn up by the Secretary.)—On account [illegible] excursion which I have the intention of making d[illegible] coming summer to Australia and New Zealand, I am [illegible] to draw up this report a month earlier [illegible]. As the time when the work of attending [illegible] and experiments repays itself is during the w[illegible] may safely say that my intention of [illegible] to

earthquake observations is not likely to involve any serious [illegible]. The number of earthquakes felt during corresponding periods [illegible] two previous years and this last year were respectively twenty-[illegible], thirty-nine, and eighty, and not only have the earthquakes [illegible] numerous, but some of them have been pretty stiff, as is test[illegible] by the fact that on several occasions chimneys fell and [illegible] were cracked. The work done during the last year is brief[illegible] follows:—

*Seismic Experiments.*—Seismic experiments were comme[illegible] in conjunction with Mr. T. Gray in 1880. The move[illegible] then recorded were produced by allowing a heavy ball, [illegible] in weight, to fall from various heights up to thirty-five [illegible]. Subsequently many experiments were made by exp[illegible] charges of dynamite and gunpowder placed in bore[illegible]. During the last year, whilst working up the long [illegible] records which accumulated, several laboratory experimen[illegible] made to investigate the methods to be employed when a[illegible] the diagrams of earth motion. The first of these ex[illegible] consisted in projecting a small ball from the top of a [illegible] vertically-placed spring, and at the same time causing [illegible] to draw a diagram of its motion. From the distance [illegible] was thrown its initial velocity could be calculated. F[illegible] diagram, either by calculation on the assumption [illegible] harmonic motion or by direct measurement, the [illegible] velocity of movement could be obtained. These three [illegible] practically agreed. The most important result [illegible] these experiments was that they indicated an importa[illegible] to be calculated in earthquake or dynamite diagr[illegible] further, that in these diagrams the first sudden movem[illegible] invariably has the appearance of a quarter-oscill[illegible] apparently to be considered as a semi-oscillation. [illegible] set of experiments consisted in determining the [illegible] calculated from an earthquake diagram which w[illegible] measure of the overturning or shattering power of a [illegible]. For this purpose a light strip of wood was caused by a strong spiral spring and a heavy weight to move [illegible] and forth with the period of the spring. On this [illegible] columns of wood were stood on end, and it was deter[illegible] far the spring had to be deflected and then suddenly [illegible] cause overturning. The more important results of [illegible] experiments are:—

I. *Effect of Ground on Vibration.*—(1) Hills have [illegible] effect in stopping vibrations. (2) Excavations exer[illegible] able influence in stopping vibrations. (3) In soft [illegible] it is easy to produce vibrations of large amplitude an[illegible] able duration. (4) In loose dry ground [illegible] dynamite yields a disturbance of large amplitude [illegible] duration. (5) In soft rock it is difficult to produce a [illegible] the amplitude of which is sufficiently great to be rec[illegible] ordinary seismograph.

II. *General Character of Motion.*—(1) The pointer [illegible] graph with a single index first moves in a normal [illegible] which it is suddenly deflected, and the resulting [illegible] figure partially dependent on the relative phases of the [illegible] transverse motion. These phases are in turn deter[illegible] the distance of the seismograph from the origin. (2) [illegible] seismograph in heating normal motion at a given [illegible] mences its indications before a similar seismograph [illegible] write transverse motion. (3) If the [illegible] such seismographs be compounded, they yield figures [illegible] loops and other irregularities not unlike the figures [illegible] the seismograph with the single index. (4) Near [illegible] the first movement will be in a straight line [illegible] origin: subsequently the motion may [illegible] and irregular. The general direction of motion, [illegible] normal. (5) Two points of ground only a few fee[illegible] [illegible] synchronous in their motions. [illegible] Earthquak[illegible] probably not a simple harmonic [illegible]

III. *Normal Motion.*—(1) N[illegible] the fi[illegible] outwards. At a distance from [illegible] be inwards. (2) At stations [illegible] [illegible] than the motion outw[illegible] [illegible] motion are [illegible] [illegible] the second or [illegible] [illegible] oscillations inwards are described more rapidly than those outwards. (7) As a disturbance radiates the period increases. Finally it becomes equal to the period of the transverse motion. From this it may be inferred that the greater the initial disturbance the greater the frequency of waves. (8) Certain of the inward motions of "shock" have the appearance of having been described in less than no time. (9) The first outwards motion, which on diagrams has the appearance of a quarter-wave, must be regarded as a semi-oscillation. (10) The waves on the diagrams taken at different stations do not correspond. (11) At a station near the origin, a notch in the crest of a wave of shock gradually increases as the disturbance spreads, so that at a second station the wave with a notch has split up into two waves. (12) Near the origin the normal motion has a definite commencement. At a distance the motion commences irregularly, the maximum motion being reached gradually.

IV. *Transverse Motion.*—(1) Near to an origin the transverse motion commences definitely but irregularly. (2) Like the normal motion, the first two or three movements are decided, and their amplitude slightly exceeds that of those which follow. (3) The amplitude of transverse motion as the disturbance radiates decreases at a slower rate than that of the normal motion. (4) As a disturbance dies out at any particular station the period decreases. (5) As a disturbances radiates the period increases. This is equivalent to an increase in period as the intensity of the initial disturbance increases. (6) As we recede from an origin the commencement of the transverse motion becomes more indefinite.

V. *Relation of Normal to Transverse Motion.*—(1) Near to an origin the amplitude of normal motion is much greater than that of the transverse motion. (2) As the disturbance radiates, the amplitude of the transverse motion decreases at a slower rate than that of the normal motion, so that at a certain distance they may be equal to each other. (3) Near to an origin the period of the transverse motion may be double that of the normal motion; but as the disturbance dies out at any given station, or as it radiates, the periods of these two sets of vibrations approach each other.

VI. *Maximum Velocity and Intensity of Movement.*—(1) An earth particle usually reaches its maximum velocity during the first inward movement. A high velocity is, however, sometimes attained in the first outward semi-oscillation. (2) The intensity of an earthquake is best measured by its destructive power in overturning, shattering, or projecting various bodies. (3) The value

$$v^2 = \frac{4}{3} g \sqrt{a^2 + b^2} \times \left(\frac{1 - \cos\theta}{\cos^2\theta}\right)$$

used by Mallet and other seismologists to express the velocity of shock as determined from the dimensions of a body which has been overturned, is a quantity not obtainable from an earthquake diagram. It represents the effect of a sudden impulse. (4) In an earthquake a body is overturned or shattered by an acceleration, $f$, which quantity is calculable for a body of definite dimensions. The quantity $f$ as obtained from an earthquake diagram lies between $\frac{v}{t}$ and $\frac{v^2}{a}$, where $v$ is the maximum velocity, $t$ is the quarter-period, and $a$ is the amplitude. (5) The initial velocity given in the formula $v^2 = \frac{2a^2}{b}$ (for horizontal projection) used by Mallet as identical with $v^2$ in 3, are not identical quantities. (6) In discussing the intensity of movement I have used the values $\frac{v^2}{a}$. (7) The intensity of an earthquake at first decreases rapidly as the disturbance radiates; subsequently it decreases more slowly. (8) A curve of intensities deduced from observations at a sufficient number of stations would furnish the means of approximately calculating an absolute value for the intensity of an earthquake.

VII. *Vertical Motion.*—(1) In soft ground vertical motion appears to be a free surface-wave which outraces the horizontal component of motion. (2) Vertical motion commences with [illegible] vibrations, and ends with vibrations which are long [illegible]. (3) High velocities of transit may be obtained by [illegible] of this component of motion. It is possibly an [illegible] the preliminary tremors of an earthquake and the [illegible]. (4) The amplitude and period of vertical [illegible] the same or different stations have been [illegible] The velocity of transit decreases as a disturbance radiates. (2) Near to an origin the velocity of transit varies with the intensity of the initial disturbance. (3) The rate at which the normal motion outraces the transverse motion is not constant. (4) As the amplitude and period of the normal motion approach in value to those of the transverse motion, so do the velocities of transit of these motions approach each other. (5) That the ratio of the speed of normal and transverse motions is not constant is shown from a table of these velocities calculated for different rocks from their moduli of elasticity.

IX. *Miscellaneous.*—(1) At the time of an earth-disturbance, currents are produced in telegraph lines. (2) The exceedingly rapid decrease in the intensity of a disturbance in the immediate neighbourhood of the epicentrum has been illustrated by a diagram. (3) For the duration of a disturbance due to a given impulse in different kinds of ground, reference must be made to the detailed descriptions of the first four sets of experiments.

*Experiments on a Building to resist Earthquake Motion.*—In the Report of last year I described a house which rested at its foundations upon cast-iron balls. These balls were 10-inch shell. The records obtained from an instrument placed inside this house showed that, although it was subjected to considerable movement at the time of an earthquake, all *sudden* motion had been destroyed. Although the balls did very much to mitigate earthquake motion, wind and other causes produced movements of a far more serious nature than the earthquake. To give greater steadiness to the house, 8-inch balls were tried, and then 1-inch balls. Finally the house was rested at each of its piers upon a handful of cast-iron shot, each ¼-inch in diameter. By this means the building has been rendered astatic, and, in consequence of the great increase in rolling friction, sufficiently stable to resist all effects like those of wind. The shot rest between flat iron plates. That the house had peculiar foundations would not be noticed unless specially pointed out. From these experiments it seems evident that it is possible to build light one-storied structures of wood or iron in which, relatively to other houses, but little movement will be felt.

*Observations in a Pit* 10 *feet deep.*—The instrument placed in this pit is similar to all the other instruments, and is installed in a similar position. Comparing the maximum amplitudes, maximum velocities, and maximum accelerations obtained in the pit with those obtained at about thirty feet distance, they are for one particular earthquake respectively in the ratios of 1 : 43, 1 : 52, and 1 : 82. In most earthquakes the extent of motion has been too small to admit of measurement, and that there had been any movement could only be detected by holding the plate on which the record was written up to the light and glancing along it lengthways. This investigation tends to confirm the view which I have previously put forward, that an earthquake at a short distance from its epicentrum is practically a surface disturbance, principally consisting of horizontal movements. The vertical motion is small, and is best seen in the preliminary tremors either of an actual earthquake or of a dynamite explosion. From a practical point of view these results must be of the greatest importance to those who have to erect heavy structures in earthquake districts.

*Buildings in Earthquake Countries.*—As during the last few years so much destruction both to life and property has taken place in various parts of Europe, it seems that an epitome of the results of observations and experiments carried on in Japan relative to construction in seismic districts might not only be interesting, but possibly it might also be of practical value. When erecting a building it appears that we ought first to reduce as far as possible the quantity of motion which ordinary buildings receive; and, second, to construct a building so that it will resist that portion of the momentum which we are unable to keep out. To reduce the momentum which usually reaches a building the following may be done:—

(1) Institute a seismic survey of the district or area in which it is intended to build, and select a site where experiment shows that the motion is relatively small. (2) For heavy buildings adopt deep foundations (perhaps with lateral freedom), or at least let the building be founded on the hardest and most solid ground. It is perhaps because the tops of the hills in Tokio are harder than the plains that they have relatively the least motion. A building only *partially* isolated may be exceedingly dangerous from the fact that motion entering in the unprotected side will make the excavations (cuttings, valleys, &c.) upon the opposite side into free surfaces which will swing forward through a range greater than they would have swung had the excavations

not existed. (3) For light buildings, especially if erected on soft ground, where the range of motion is always great, if the structure rests on layers of fine cast-iron shot, it cannot possibly receive the same momentum as a building attached to the moving ground. To resist the effects of momentum which cannot be cut off a building: (1) Bear in mind the fact that it is chiefly stresses and strains which are applied horizontally to a building which have to be encountered. A vertical line of openings like doors or windows in a building constitute a vertical line of weakness to horizontally-applied forces. (2) Avoid coupling together two portions of a building which have different vibrational periods, or which from their position are not likely to synchronise in their motion. If such parts of a building must of necessity be joined, let them be so joined that the connecting link will force them to vibrate as a whole, and yet resist fracture. Brick chimneys in contact with the framing of a wooden roof are apt to be shorn off at the point where they pass through the roof. Light archways connecting heavy piers will be cracked at the crown. To obviate destruction due to these causes a system of construction similar to that to be seen in several of the buildings of San Francisco, Tokio, and Yokohama may be adopted. This essentially consists of tieing the building together at each floor with iron and steel tie-rods crossing each other from back to front and from side to side. (3) Keep the centre of inertia of a building or its parts as low as possible. Heavy tops to chimneys, heavy copings, and balustrades on walls and towers, heavy roofs and the like are all of serious danger to the portion of the structure by which they are supported. When the lower part of a building is moved, the upper part by its inertia tending to remain behind often results in serious fractures. All the chimneys in Tokio and Yokohama which have fallen in consequence of their ornamental heads have been replaced by shorter and thicker chimneys without the usual coping. The roof of a portion of the Engineering College rests loosely on its walls, and has therefore a certain freedom. In Manila many heavy roofs have been replaced by roofs of sheet iron. Walls may be lightened in their upper parts by the use of hollow bricks. Such vertical motion as may exist is also partly obviated by light superstructures. Vertically-placed iron tie-rods give additional security. If these and other rules which are the result of experiment and observation could be adopted in earthquake countries, it is certain that the loss of life and property might be greatly diminished.

*Earth Tremors and Earth Pulsations.*—Notwithstanding the untrustworthiness of level observations, they nevertheless have given results of interest. (1) The bubbles from time to time move back and forth without apparent reason. Considerable changes have sometimes been observed before an earthquake (2) The greatest movement of the bubble of a level takes place during the colder part of the year, which is the season of earthquakes, and also the season when the barometric gradient between Siberia and the Pacific is the steepest. (3) The bubble of a level continues to move long after the sensible motion of an earthquake has ceased, enabling us to study the slow movements which bring an earthquake to a close. (4) When the barometer is very low, as, for instance, during a typhoon, the bubble of a level may be distinctly seen to pulsate back and forth through a range of about ·5 mm. In September of last year, in conjunction with Mr. W. Wilson, C.E., and Mr. Mano, of the Imperial College of Engineering, I carried an instrument to the summit of Fujiyama, which is about 12,365 feet in height, where I succeeded after many failures in recording automatically earth tremors and earth pulsations. But we were unable to remain for more than five days.

The results of interest connected with these observations are:—(1) That the movements on the top of the mountain were much greater than those which I usually observe in Tokio. (2) The tremors, or slight swing-like movements of the instrument, did not necessarily accompany the wind. (3) That during the heavy south and south east gales the direction of displacement of the pointer was towards the south-east, which is the same result as would be obtained if the bed-plate of the instrument were raised on the south east side, or if the mountain had tipped over to the north west. My colleague, Mr. T. Alexander, treating Fuji as a conical [illegible] made of brick, with a wind load of 50 lbs. on the square foot, found the slope and deflection of a point 100 feet below the apex of the cone. This calculated slope was two or three times greater than the greatest deflection which I measured. As it is difficult to imagine that a mountain could suffer deflection by a wind pressure I will not insist on the fact that deflection actually occurred. It is certainly curious that the results of calculation and observation should point in the same direction.

*Report of the Committee on Electrical Standards, consisting of Prof. G. C. Foster, Sir W. Thomson, Prof. Ayrton, Prof. J. Perry, Prof. W. G. Adams, Lord Rayleigh, Prof. O. J. Lodge, Dr. John Hopkinson, Dr. A. Muirhead, Mr. Preece, Mr. H. Taylor, Prof. Everett, Prof. Schuster, Dr. J. A. Fleming, Prof. G. F. Fitzgerald, Mr. R. T. Glazebrook, Prof. Chrystal, Mr. H. Tomlinson, and Prof. Barrett, with Mr. Glazebrook as Secretary.*—The Committee reported that the Secretary has had constructed a series of coils to serve as standards in terms of the legal ohm. These standards, in accordance with the resolutions of the Committee, were constructed on the supposition that the value of the legal ohm is 1·0112 B.A. units. The comparisons were made by the methods given in the reports for 1883 and 1884, and the values found were—

| No. | | Resistance | | Temperature |
|---|---|---|---|---|
| 100 | ... | ·999515 | ... | 14·1 |
| 101 | ... | ·998845 | ... | 14·1 |
| 102 | ... | 10·00415 | ... | 16·7 |
| 103 | ... | 10·00352 | ... | 16·75 |
| 104 | ... | 100·0304 | ... | 16·05 |
| 105 | ... | 100·0436 | ... | 16·05 |
| 106 | ... | 1000·694 | ... | 17·4 |
| 107 | ... | 1000·677 | .. | 17·45 |
| 108 | ... | 10006·8 | ... | 17·35 |
| 109 | ... | 10006·8 | ... | 17·35 |

These standards have also been compared with mercury tube resistances constructed by Mr. Benoit, of Paris, and a difference of ·00049 legal ohm was found. The legal ohm standards, as constructed by the Committee, exceed by this amount those constructed in Paris. Six coils have been compared with the standards during the year, and the values are given. The Committee hope that arrangements may be made for issuing standards of electromotive force, and for constructing and issuing standards of capacity. In conclusion, they ask to be reappointed, with the addition of the names of Prof. J. J. Thomson and Mr. W. N. Straw, with a renewal of the unexpended grant of 50*l.*

*Report on Electrical Theories*, by Prof. J. J. Thomson.—This report deals exclusively with those theories which only profess to give mathematical expressions for the forces due to a distribution of currents. Those theories which profess to give mechanical explanation of these forces are not considered. There was not sufficient time to consider both classes of theories, and it is evident that the mathematical theory must be settled before we can get a satisfactory mechanical one. As to the general result of the inquiry, we may say that all that has been proved is that it is absolutely necessary to take into account the currents in the dielectric; and that the action of these, as well as other currents, must be given by some form of the potential theory—that is, the theory propounded by F. E. Neumann and generalised by Von Helmholtz. But nothing definite is known as to what we should take as the measure of these electric currents, and which of the many forms of the potential theory is the right one. We have to require experimental proof that alteration in the polarisation of the dielectric, at any rate if the dielectric be other than the ether, produce effects analogous to those produced by an ordinary current flowing through a conductor. For the polarisation of a dielectric by an electromotive force produces a change in the structure of the dielectric. This is shown by the alteration of volume experienced by glass and other bodies when placed in the electric field, and also by the breaking down of the dielectric when the strength of the field is great enough. Now, if we move a magnet we shall, since we produce an electromotive force in its neighbourhood, produce a change in the structure of the dielectric around it because we alter its state of polarisation. It follows, then, from the principle of action and reaction, that if we alter the state of polarisation of the dielectric we shall alter the state of motion of the magnet, [illegible] that an alteration in the polarisation of the dielectric p[illegible] force. We can show in a similar way that an [illegible] polarisation must produce all the effects pro[illegible] conduction current. We know nothing, [illegible] the [illegible] of the current which is equiva[illegible] polarisation. It seems natural [illegible] current is proportional [illegible] Let [illegible] that [illegible] change of the electromotive force). The quantity $\eta$ has never been experimentally determined, but two hypotheses have been made as to its value by Maxwell and Helmholtz. According to Maxwell $\eta = \kappa/4\pi$, where $\kappa$ is the specific inductive capacity, and, according to Helmholtz, $\eta$ is also a function of $\kappa$. There is very little experimental evidence for either of these theories. For Maxwell's theory, perhaps the best evidence is that, if we assume the electro-magnetic theory of light, the refractive index should, if $\eta = \kappa/4\pi$, equal the square root of a specific inductive capacity, which is very approximately the case for a good many substances. Maxwell's assumption has the great advantage of getting rid of all discontinuity in the currents; and, when this is the case, all forms of the potential theory lead to the same result. So that, if we could prove Maxwell's theory experimentally, it would be a complete theory of electro-dynamic action. If it should turn out, however, that Maxwell's theory is not true, then we should have to go on further and determine which of the several forms of the potential theory is the true one; as, if the currents are not closed, the different forms of the theory lead to different results. It would seem that the most important thing to be done in electro-dynamic theory is to determine whether $\eta = \kappa/4\pi$ or not, and the author has described two ways in which this may be done. If Maxwell's theory should prove not to be true, we must go on to determine the value of $\eta$ for all dielectrics, and which of the forms of the potential theory is the true one.

*Report on Standards of White Light.*—Various experiments have been made by the Committee. The members have come to the conclusion that the standard candle as defined by Acts of Parliament is not in any sense a standard. The spermaceti used is not a definite chemical substance, and is mixed with other substances. Also the constitution of the wick is not properly defined. The Committee have considered the relative merits of different proposed standards, and have come to the conclusion that for *commercial* purposes the pentane standard of Mr. Vernon Harcourt is the best. Although the Committee wish their opinion on this point to be known to the Board of Trade and the public, they do not recommend the adoption of any particular standard until further experiments on radiation have been made. Several experiments are enumerated which they propose to make. They ask reappointment, with a grant of 50*l.* towards the proposed researches.

*Report of the Committee on Meteoric Dust.*—Experiments have been made at the Scottish Marine Station by means of an apparatus in which the wind blows through gratings of fine platinum wire. The moisture deposited is collected and examined for suspended particles. Funnels have also been placed at different localities for catching rain. The presence of carbonaceous matter is most marked. In smaller quantities occur quartz, felspar, mica, tourmaline, garnet, glassy particles resembling Krakatoa dust or pumice, and small round magnetic particles about 1-500th of an inch in diameter. They resemble similar larger particles got from deep sea deposits at the greatest distance from continental land. None are of cosmic origin. Usually they have a small nucleus in the interior, but are frequently hollow. Further observations are to be made at various stations all over the world.

*Report of the Committee on Meteorological Observations on Ben Nevis.*—The chief additional observations made during the year were with regard to rainfall and wind. The amount of water substance deposited, in whatever form, has been collected by specially-designed gauges and measured every hour since June 24, 1884. In the end of October the anemometers designed by Praf. Chrystal were added to the instruments. But during seven months—November, 1884, to May, 1885—no anemometer could indicate results, with the exception of thirty days. This is owing to the deposition of ice-crystals. The greatest speed indicated during three days was on the night of April 24. The mean speed for 12 hours was 74 miles per hour, the speed for one particular hour being 81 miles per hour. The highest temperature reached, 60°·1 F., occurred at 2 p.m., August 9; and the lowest, 11°·1 F., at midnight, February 16. The coldest week—average temperature, 16°·2 F.—was the one ending on February 21. The changes of temperature, particularly in winter, were caused, not by direct solar influence, but by the passage of cyclones or anticyclones over the observatory. Indeed ... stormy months of winter this may be taken to be accu... ...e case. In summer the afternoon minimum of atmo... ...essure was 0·007 inches above the mean for the whole day, but in winter it was below the mean. During twelve months there were 464 hours of sunshine, being about 11 per cent. of the total possible amount. Heavy rainfalls frequently occur. The longest for one hour was on December 10, 1884. The largest daily fall occurred then also, being 4·264 inches. On an average, a fall of at least one inch occurred one day in seven.

*Report of the Committee on Solution.* Secretary Dr. W. W. J. Nicol.—The subjects discussed in this Report are:—(1) Molecular volumes, (2) saturation, (3) supersaturation, (4) vapour pressures, and (5) expansion of salt solutions. (1) The results of a series of experiments show the molecular volume of a salt in dilute solution to be a quantity composed of two constants: one for the metal and the other for the salt radical; hence the same volume change is produced by replacement of one metal or salt radical by another metal or salt radical. *Water of crystallisation* is not to be distinguished from the solvent water, but the *water of constitution* possesses a volume different from that of the rest of the water—results showing the existence in solution of the anhydrous salt in contradistinction to the view that a hydrate, definite or indefinite, is formed in solution. (2) Saturation is reached when the further addition of salt would produce diminution of the mean molecular volume of the molecules already present. (3) The so-called supersaturated solutions are simply saturated or non-saturated solutions of the anhydrous salts, the only truly supersaturated solutions being those which result from the fact that, when a hot solution is cooled, a finite time is required for the excess of salt to crystallise out.

*The Report of the Committee appointed to investigate by means of Photography the Ultra-violet Spark Spectra emitted by Metallic Elements and their Combinations under Varying Conditions,* drawn up by Prof. Hartley, F.R.S., was presented by him to the Section; in it an account is given of the results of the investigation of the changes in the character of the spectra of the metals produced by variation in the strengths of the solutions of their salts—*e.g.* chlorides, nitrates, or sulphates. The study of a very considerable number of the photographs of such spectra shows the strength of the solution to have a marked effect on their character, the more dilute the solution the smaller the number of lines; further, that under the same spark conditions, similar solutions of the same strength emit the same spectrum. Solutions containing 1 per cent., 1-10th, 1-100th, and 1-1000th of the metal were used; solutions of the latter strength seldom gave a spectrum of more than three or four lines, and with solutions containing less than 1-10th per cent. the diminution in the number of lines is usually very marked. The spectrum reaction may be utilised for the quantitative analysis of minerals, and yields results more reliable than those obtained by ordinary methods. The reaction is extremely delicate, and in the case of magnesium one part of the metal in 10,000 millions of solution can be detected by the appearance of two characteristic lines.

*Third Report of the Committee, consisting of Profs. Williamson, Dewar, Frankland, Crum Brown, Odling, and Armstrong, Drs. Hugo Muller, F. R. Japp, and H. Forster Morley, and Messrs. A. G. Vernon Harcourt, C. E. Groves, J. Millar Thomson, H. B. Dixon (Secretary) and V. H. Veley, reappointed for the purpose of drawing up a Statement of the Varieties of Chemical Names which have come into use, for Indicating the Causes which have led to their Adoption, and for Considering what can be done to bring about some Convergence of the Views on Chemical Nomenclature obtaining among English and Foreign Chemists.*—An account of the authorship of some of the various systems of nomenclature which have been devised for the purpose of distinguishing between compounds formed by the union of the same elements in different proportions has been given in the "Historical Notes" prefixed to the Second Report of this Committee. Among these systems the use of the termination *ous* and *ic*, to denote respectively lower or higher degrees of saturation of one element or group with another element or group, is perhaps that which has met with the widest acceptance. This system further directs that when electro-negative groups, the names of which end in *ous* and *ic*, unite with electro-positive groups to form salts, these terminations are to be changed into *ite* and *ate* respectively. It would be ill-advised to attempt on etymological grounds to change a system so firmly established as that involved in the present use of the prefixes *hypo* and *hyper*. No ambiguity can arise from the use of terms about the meaning of which every one is agreed, and their mere etymological accuracy is, in view of this all-important consideration, of secondary importance. As a metal rarely—if ever—forms more than two salifiable oxides, the *ous* and *ic* terminations generally suffice for purposes of distinction so far as the salts of metals are concerned. The practice of further employing these terminations in the case of acid-forming oxides does not lead to confusion, since these oxides are distinguished by the name *anhydride* (or *acid*). Thus we have

| $CrO$ | $Cr_2O_3$ | $CrO_3$ |
|---|---|---|
| Chromous oxide. | Chromic oxide. | Chromic anhydride. (Chromic acid.) |

Indifferent oxides have frequently been classified and named by regarding them as compounds of salifiable, with acid-forming oxides, $Cr_3O_4$ being termed *chromic chromate*. For stages lower than *ous*, the prefixes *hypo* and *sub* are employed. Custom appears to have restricted *hypo* chiefly to acids and to acid-forming oxides, *sub* to salifiable and to indifferent oxides. With regard to the termination *ous*, the minor question arises, how far this termination ought to be written in the forms *ious* and *eous*. The answer is: as seldom as possible. "Cupreous" has generally given way to "cuprous"; no one writes "chromious" (although the name of the metal is "chromium"); and there is no reason why such names as "ruthenious" and "iridious" should not equally be shorn of their superfluous penultimate syllable. A further question, concerning which considerable difference of opinion has prevailed, is whether any *ous* or *ic* terminations ought to be employed in the names of salts of which only one class is known—thus *magnesic sulphate* instead of *magnesium sulphate*. There is something to be said here for both systems; and, as the diversity of practice does not lead to confusion, and consequently does but little harm (beyond in each case offending the ears of those accustomed to the opposite system), the question need not be regarded as a vital one. In the case of carbon compounds, however, there is a distinct advantage in affixing *ic* to the names of the positive radicals in ethereal salts. A neglect of this precaution leads to ambiguity—at all events in the *spoken* name. Thus, though there is no ambiguity in the name *ethyl phenylacetate* when written, yet the ear cannot distinguish between it and *ethylphenyl acetate*. This ambiguity is obviated by the use of the termination *ic*—thus, *ethylic phenylacetate* and *ethylphenylic acetate*. In the use of the terminations *ous* and *ic* to distinguish different series of *acids and acid-forming oxides*, with the exception of one or two isolated cases, almost perfect unanimity has prevailed. To sum up, the *ous* and *ic* terminations when employed for purposes of distinction in cases where two series of oxides, acids, salts, &c., are known, have been almost free from ambiguity, and for this reason deserve to be retained. On the other hand, in cases where only one series is known, those chemists who have employed one or other of these terminations have occasionally differed as to which ought to be used: the difficulty may be solved, as it has been done by some chemists, by avoiding the use of any termination in such cases. In complex cases where the above modes of naming prove inadequate, recourse may be had to numeral designations. These appear especially admissible in cases where an oxide occurs which is intermediate between the *ous* and the *ic* stage, and at the same time cannot be classed as a compound of oxides already classified and named. In applying numeral designations it is most important to select only such as are free from hypothesis and which afford correct information. In this respect chemists appear not to have been sufficiently careful of late years. As an example, *arsenious oxide* may be quoted; this compound is frequently termed "arsenic trioxide," the formula being written $As_2O_3$, and it is tacitly assumed that the molecule contains three oxygen atoms. There are three objections to this name:—(1) That, assuming the formula on which it is based to be correct, it affords no information as to the number of *arsenic* atoms associated with the *three* oxygen atoms; (2) that it involves the assumption that arsenious oxide does not vary in molecular weight, whatever its physical state; and (3) that the formula of [illegible] oxide is $As_4O_6$. In employing numeral designations [illegible] ate molecular composition in cases where this is established it is therefore important to express the number of atoms of each constituent element, as *dicarbon hexachloride*, $C_2Cl_6$. But in the case of solid and liquid bodies of which the molecular weight is unknown, or which may vary with temperature, the name should merely indicate the relative proportions in which the constituents are associated; or, more explicitly, the name should indicate the proportion of the radical associated with what [illegible] be termed the characteristic element of the compound. [illegible] difficulty occurs in the case of the chloride, or analogous [illegible] pound, of the monad elements generally, these being [illegible] mono-, di-, tri-, tetra-, penta-, or hexa-chloride, &c., [illegible] as combination is in the proportion of 1, 2, 3, 4, 5, or 6 [illegible] of chlorine to 1 atom of the characteristic element. The [illegible] cation of this system would involve the use of the name [illegible] dichloride and iron trichloride (not sesqui-chloride) for [illegible] and ferric chlorides respectively, names which accurately [illegible] the relative proportions of metal and of chlorine in these [illegible] pounds without any hypothesis as to their molecular [illegible] sition, which in the case of the former compound, at all [illegible] certainly depends on temperature. It will, however, [illegible] slight departure from the existing practice when [illegible] oxides, sulphides, and other compounds of polyad [illegible] thus oxides of the type $(R_2)''O$ would be termed *hemi*[illegible] since they consist of the characteristic element and [illegible] the proportion of *one* atom of the former to *half* an at[illegible] latter. Oxides of the type $(R_2)^{vi}O_3$ would be termed [illegible] oxides, since the characteristic element and oxygen are [illegible] in the proportion of *one* of the former to *one and a ha*[illegible] latter. Oxides of the type $R_2O_5$ would be termed *se*[illegible] as they contain oxygen and the characteristic element [illegible] proportion of *two and a half* atoms of the former to *on*[illegible] latter. Oxides of the types $RO$, $RO_2$, $RO_3$, and $RO_4$, [illegible] termed respectively *mono-*, *di-*, *tri-*, and *tetr-*troxides.

The remainder of the report treats of the various [illegible] which have been proposed for the naming of acid, [illegible] double salts.

*Report of the Committee appointed for the purpose of [illegible] in to the Rate of Erosion of the Sea-Coasts of En*[illegible] *Wales, and the Influence of the Artificial Abstraction* [illegible] *or Material in that Action (C. E. De Rance and* [illegible] *Secretaries).*—The Committee has, during the past year, [illegible] several Returns relating to the south and east coasts of [illegible] Most of those relating to the coast south of the Tha[illegible] printed. The thanks of the Committee are especially [illegible] Major-Gen. Sir A. Clarke, who has instructed the officers [illegible] Royal Engineers stationed around the coast to supply [illegible] mittee with such information as they may possess or [illegible] obtain. Further returns are expected from the same [illegible] ment and from other official sources; the Committee [illegible] think it best to defer any general Report until more [illegible] information is obtained. The Memorandum drawn [illegible] J. B. Redman so fully sets forth the work of the Co[illegible] and the importance of the inquiry referred to it, that [illegible] printed. The Memorandum by Mr. G. Dowker, on Ea[illegible] gives a sufficiently complete account of the changes of [illegible] in this district; changes which are of especial historical [illegible] ance and interest. Mr. Whitaker has drawn up a list [illegible] relating to the coast-changes of England and Wales, wh[illegible] be of great service to the Committee and to those wh[illegible] assist in the work. The Committee would again ask [illegible] assistance of any who, by long residence or other mean[illegible] special knowledge of changes on any part of the Engl[illegible] Welsh coast. Printed forms of questions can be obtained [illegible] the secretaries or from any member of the Committee.

*Third Report of the Committee, consisting of Sir J. H*[illegible] *Dr. Gunther, Mr. Howard Saunders, and Mr. Sclater* [illegible] *tary), appointed for the purpose of exploring Kilima-njaro an*[illegible] *adjoining mountains of Equatorial Africa.*—In their last re[illegible] presented at Montreal, the Committee stated the arrange[illegible] that they had made with Mr. H. H. Johnston for under[illegible] an expedition to Kilima-njaro, and gave extracts from [illegible] Johnston's letters showing the progress of his expedition [illegible] May, 1884. Mr. Johnston gave an account of his expedition [illegible] the Royal Geographical Society at their meeting on Janu[illegible] 26, 1885, in which he states that in consequence of the desertion [illegible] of two natives whom he had taken out with him from Zanzibar [illegible] as collectors, the collections were not so large as the Committee could have wished. Capt. Shelley prepare[illegible] birds collected by Mr. Johnston, and M[illegible] the butterflies of his collection, after wh[illegible] these collections were handed over to t[illegible] were also all the other zoological collect[illegible] [illegible] reports might be prepa[illegible] [illegible] as seemed to be [illegible] [illegible] collections [illegible]

Johnston have already been published in the *Proceedings* of the Zoological Society for this year. The botanical collections were handed over to the Royal Herbarium at Kew, where they were arranged, named, and a set sent to the British Museum. The report upon them is ready, and will be presented to the Linnean Society for publication. Prof. Bonney has kindly undertaken to report on the rock and mineral specimens collected by Mr. Johnston, and his report is presented herewith, and will be read in the Geological Section. Mr. H. H. Johnston has in preparation a volume containing a narrative of his expedition and a summary of the results arrived at, which will shortly be ready for issue. The sum of 25*l*. granted to the Committee at the Montreal meeting has been returned to the treasurer.

*Report of the Committee, consisting of Dr. E. B. Tylor, Dr. G. M. Dawson, Gen. Sir J. H. Lefroy, Dr. Daniel Wilson, Mr. Horatio Hale, Mr. R. G. Haliburton, and Mr. George W. Bloxam (Secretary), appointed for the purpose of investigating and publishing Reports on the Physical Characters, Languages, Industrial and Social Condition of the North-Western Tribes of the Dominion of Canada.*—The Committee have been in active correspondence with missionaries and others stationed among the Indians, but the unsettled state of the country during the past year has made it impossible to do more than collect materials for a preliminary report; the Committee, therefore, ask that they may be reappointed with a continuance of the grant.

*Report on the Blackfoot Tribes. Drawn up by Mr. Horatio Hale.*—The tribes composing the Blackfoot Confederacy, as it is commonly styled, have been until recently less known than any others. A correspondence was opened with two able and zealous missionaries residing among these Indians. The Rev. Albert Lacombe, widely and favourably known as Father Lacombe, Roman Catholic Missionary among the Siksika, or proper Blackfeet Indians, and the Rev. John McLean, Missionary of the Canadian Methodist Church to the Blood and Piegan (or Kena and Piekanè) tribes. Father Lacombe has been many years a missionary in the Canadian North-West, and has a very extensive knowledge of the tribes of that region. His elaborate work, the "Grammar and Dictionary of the Cree Language" ranks among the best contributions to American philology. Mr. McLean has been engaged in his missionary duties for five years, has prepared a grammar of the Blackfoot language, and is at present occupied in translating the Scriptures into that tongue. The unfortunate troubles of the past season have for a time interrupted the correspondence, and the principal portion of the report on these Indians will therefore have to be deferred for another year. Some other sources of information, however, have been examined, particularly the valuable official reports and maps of the Canadian and United States Indian Departments.

Fifty years ago the Blackfoot Confederacy held among the western tribes much the same position of superiority which was held two centuries ago by the Iroquois Confederacy among the Indians east of the Mississippi. The nucleus, or main body is still composed of three tribes, speaking the proper Blackfoot language: the Siksika, or Blackfeet proper; the Kena, or Blood Indians; and the Piekanè, or Piegans (pronounced Peegans), a name sometimes corrupted to "Pagan" Indians. To these are to be added the Sarcees from the north, and the Atsinas from the south. The Sarcees are an offshoot of the great Athabascan stock, which is spread over the north of British America, through Oregon and California into Northern Mexico. The Atsinas, who have been variously known as Fall Indians, Rapid Indians, and Gros Ventres, speak a dialect similar to that of the Arapohoes, who now reside in the "Indian Territory" of the United States. It is a peculiarly harsh and difficult language, and is said to be spoken only by those two tribes. None of the Atsinas are now found on Canadian territory, and no recent information has been obtained concerning them, except from the map which accompanies the United States Indian Report for 1884, and on which their name appears on the American Blackfoot Reservation. The five tribes were reckoned, fifty years ago, to comprise not less than 30,000 souls, the terror of all the western Indians on both sides of the Rocky Mountains. It was not uncommon for thirty or forty [illegible]rties to be out at once against the Salish (or Flatheads) [illegible], the Upsarokas (or Crows) of the Missouri Plains, the [illegible] of the far south, and the Crees of the north and [illegible]untry which the Blackfoot tribes claimed properly [illegible]mprised the valleys and plains along the eastern slope of the Rocky Mountains, between the Missouri and the Saskatchewan, the favourite resort of the buffalo, whose vast herds afforded the Indians their principal means of subsistence. In the year 1836 a terrible visitation of the small-pox swept off two-thirds of the people, and five years later they were supposed to count not more than 1,500 tents, or about 10,000 souls. Their enemies were then recovering their spirits, and retaliating upon the weakened tribes the ravages which they had formerly committed.

In 1855 the United States Government humanely interfered to bring about a complete cessation of hostilities between the Blackfoot tribes and the other Indians, and framed a treaty for them, accompanying the act by a large distribution of presents. Dr. F. V. Hayden, in his account of the Indian Tribes of the Missouri Valley, states: "From my own experience among them, and from information derived from intelligent men who have spent the greater portion of their lives with them, I am convinced that they are among the most peaceable and honourable Indians in the West; and in an intellectual and moral point of view they take the highest rank among the wild tribes of the plains." This favourable opinion of Dr. Hayden is entirely in accordance with the testimony of the Indian agents and other officials of the Canadian North-West. At the present time, while constantly harassed on their reserves by the incursions of thievish Crees and other Indians, they forbear to retaliate, and honourably abide by the terms of their treaty, which binds them to leave the redress of such grievances to the Dominion authorities. Since the general peace the numbers of the Blackfeet have apparently qeen on the increase. Dr. Hayden reports the three proper Blackfeet tribes as numbering in 1855 about 7000 souls. The present population of the three Canadian Reserves is computed at about 6000, divided as follows: Blackfeet proper, 2400; Bloods, 2800; Piegans, 800. On the American Reservation there are stated to be about 2300, mostly Piegans. This would make the total population of the three tribes exceed 8000 souls. The adopted tribe, the Sarcees, have greatly diminished in numbers through the ravages of the small-pox. This tribe, now numbering less than 500 souls, have their Reserve near Calgary. They are reputed to be less cleanly and moral than the proper Blackfeet tribes. In this respect their habits and character correspond with those of other Athabascan tribes. During the past five years, as is well known, a great change has taken place in the condition of the north-western tribes through the extermination of the buffalo. The Blackfeet have been the greatest sufferers from this cause. The buffalo were their main dependence. Suddenly, almost without warning, they found themselves stripped of nearly every necessary of life. The change was one of the greatest that could well befall a community. The Governments both of the United States and of Canada came to the rescue; but in the former country the urgency of the case was not at first fully understood, and much suffering ensued. The agent on the Blackfoot Reservation in Montana (Major Allen) states in his official report that when he entered upon his duties in April 1884 he found the Indians in a deplorable condition. The supplies of food which had been sent for them had proved insufficient, and before these could be renewed many died from actual starvation. Some stripped the bark from the saplings which grew along their creeks, and ate the inner portion to stifle their sense of hunger. On the Canadian side, fortunately, the emergency was better understood. Col. McLeod, an able and vigilant officer, was in charge of the Mounted Police at that time, and through his forethought the necessary preparations were made. In 1879 and 1880 the buffalo disappeared from that region. Arrangements were at once made for settling the Indians on Reserves, and for supplying them with food and clothing, and teaching them to erect wooden houses and cultivate their lands. Daily rations of meat and flour were served out to them. Ploughs, cattle, and horses were furnished to them. Farm instructors were placed among them. The Indians displayed a remarkable readiness to adapt themselves to the new conditions. According to the reports of all the agents, they have evinced a quickness to learn and a persevering industry which place them decidedly in advance of the other Indian tribes of that region. In 1882 more than 500,000 lbs. of potatoes were raised by the three Blackfoot tribes, besides considerable quantities of oats, barley, and turnips. The Piegans had sold 1000 dollars' worth of potatoes, and had a large supply on hand. "The manner in which the Indians have worked," writes the agent, "is really astonishing, as is the interest they have taken, and are taking, in farming." Axes and other tools were distributed among them, and were put to good use. In November, 1882, log-houses had "gone up thick and fast on the Reserves, and were most creditable to the builders." In many cases the logs were hewn, and in nearly all the houses fireplaces were built. In the same year another official found comfortable dwellings, well-cultivated gardens, and good supplies of potatoes in root-houses. Most of the families had cooking stoves, for which they had sometimes paid as much as 50 dollars. He "saw many signs of civilisation, such as cups and saucers, knives and forks, coal-oil lamps, and tables; and several of the women were baking excellent bread and performing other cooking operations." Three years before these Indians were wild nomads, who lived in skin tents, hunted the buffalo, and had probably never seen a plough or an axe.

The Blackfeet have been known to the whites for about a century, and during that period have dwelt in or near their present abode. There is evidence, however, that they once lived further east than at present. The explorer Mackenzie, in 1789, found them holding the south branch of the Saskatchewan, from its source to its junction with the north branch. He speaks of four tribes—the Picaneaux, Blood, and Blackfeet, and the Fall Indians (Atsinas), which latter tribe then numbered about 700 warriors. Of the three former tribes he says: "They are a distinct people, speak a language of their own, and, I have reason to think, are travelling north-west, as well as the others just mentioned (the Atsinas); nor have I heard of any Indians with whose language that which they speak has any affinity. Mr. McLean's inquiries confirm this opinion of the westward movement of these Indians in comparatively recent times. "The former home of these people," he writes, "was in the Red River country, where, from the nature of the soil which blackened their mocassins, they were called Blackfeet." This, it should be stated, is the exact meaning of *Siksika*, from *siksinam*, black, and *ka*, the root of *oqkatsh*, foot. The meaning of the other tribal names, *Kena* and Piekanè, is unknown. This westward movement has probably been due to the pressure of the Crees, who, according to their own tradition, originally dwelt far east of the Red River, in Labrador and about Hudson's Bay. They have gradually advanced westward, pushing the prior occupants before them by the sheer force of numbers. This will explain the deadly hostility which has always existed between the Crees and the Blackfeet. M. Lacombe, however, expresses a doubt as to their former sojourn in the Red River region: "They affirm, on the contrary, that they came from the south-west, across the mountains—that is from the direction of Oregon and Washington Territory. There were" (he adds) "bloody contests between the Blackfeet and the Nez-percés, as Bancroft relates, for the right of hunting on the eastern slope of the Rocky Mountains." Mr. McLean, who mentions the former residence of the Blackfeet in the Red River country as an undoubted fact, also says: "It is supposed that the great ancestor of the Blackfeet came across the mountains." Here are two distinct and apparently conflicting traditions, each having good authority and evidence in its favour. One of the best tests of the truth of tradition is to be found in language. Mackenzie, well acquainted with the Crees and Ojibways, who speak dialects of the great Algonkin stock, recognised no connection between their speech and that of the Blackfeet. Another traveller (Umfreville), whose book was published in 1791, gave a list of forty-four words of the Blackfoot language. Albert Gallatin, whose "Synopsis of the Indian Tribes" appeared in 1836, examined this list of Umfreville, and pronounced it sufficient to show that the language of the Blackfeet was "different from any other known to us." A few years later, having received from an Indian trader a more extended vocabulary, he corrected his former statement, and showed that there was a clear affinity between the Blackfoot speech and the language of the Algonkin family. More recently the French missionaries made the same discovery. M. Lacombe writes to me: "The Blackfoot language, although far from, belongs to the same family as, the Algic, Ojibway, Santeux, Maskegon, and Cree. We discovered this analogy by studying the grammatical rules of these languages." Thus some of the ablest and most experienced of North American linguists have at first supposed the Blackfoot language to be distin[illegible] from all others, and have only discovered its connection [illegible] Algonkin family by careful study. M. Lacomb[illegible] enough to send me a pretty extensive vocal[illegible] words, compared with the corresponding wo[illegible] Ojibway languages. He has added m[illegible] grammatical forms in the Blackfoot, compared with similar for[illegible] in the Cree and Ojibway tongues. The Blackfoot language [illegible] thus shown to be, in its grammar, purely Algonkin. The re[illegible]semblance is complete in the minutest forms. But when we turn to the vocabulary, by which the first judgment of a language is necessarily formed, the origin of the early er[illegible] becomes apparent. Many of the most common words are totally different from the corresponding words in the Algonki[illegible] languages. Others, found on careful examination radically the same as the corresponding Algonkin terms, are yet so change[d] and distorted that the resemblance is not at first apparent. [illegible] this variation and distortion the numerals afford a good exam[ple]. Other words in ordinary use show the total unlikeness in [illegible] cases and the distorted resemblance in others. The posse[ssive] pronoun "my" is expressed by the same prefix *ni* (or *n'*) [illegible] three languages. Pursuing this trace we compare the pers[onal] pronouns, and find a close resemblance, the difference [illegible] mainly in the terminations. In the possessive prefixes the re[illegible]semblance is still more notable. Thus in the Blackfoot langua[ge] *n'otas* means "my horse, or dog" (the same word, [illegible] enough, applying in this form to both animals); and in [illegible] *n't'em* has the same meaning. These words are thus [illegible] with the possessive pronouns and in the two numbers:—

| | Blackfoot | Cree |
|---|---|---|
| My horse (or dog) | n'otas | n't'em |
| thy ,, ,, | k'otas | kit'em |
| his ,, ,, | otas | otema |
| our ,, ,, | n'otasinan | n't'eminan |
| your ,, ,, | k'otasinan | kitemiwaw |
| their ,, ,, | otasiwaw | otemiwawa |
| my horses (or dogs) | n'otasiks | n't'emak |
| thy ,, ,, | k'otasiks | kit'emak |
| his ,, ,, | otasiks | otema |
| our ,, ,, | notasinaniks | n't'eminanak |
| your ,, ,, | kotasiwaweks | kitemiwawak |
| their ,, ,, | otasiwaweks | otemiwawa |

It will be seen that the close resemblance in grammar [illegible] striking as the wide difference in the vocabulary. These [illegible] admit of but one explanation. They are the precise phe[nomena] to which we are accustomed in the case of mixed language[s]. [In] such languages—our English speech is a notable exam[ple]—[we] expect the grammar to be derived entirely from one [illegible] while the words will be drawn from two or more. Further[illegible]more, wherever we find a mixed language we infer a co[nquest of] one people by another. In the present instance we may [illegible] suppose that when the Blackfoot tribes were forced west[ward] from the Red River country to the foot of the Rocky Mountains they did not find their new abode uninhabited. It is pr[obable] enough that the people whom they found in possession had [illegible] through the passes from the country west of those moun[tains]. If these people were overcome by the Blackfeet, and [illegible] women taken as wives by the conquerors, two results w[ould be] likely to follow. In the first place, the language would be[come] a mixed speech, in grammar purely Algonkin, but in the voca[bu]lary largely recruited from the speech of the conquered [illegible]. A change in the character of the amalgamated people w[ould] also take place. The result of this change might be here inferred if we knew the characteristics of both the [con]stituent races. But it may be said that a frequent, if [not] a general, result of such a mixture of races is the produc[tion] of a people of superior intelligence and force of characte[r]. The circumstances thus suggested may account, not only for the peculiarities of the language and character of the Blackfeet tribes, but also for the different traditions which are found among them in regard to their origin and former abode. It would be very desirable to trace that portion of the Blackfoot vocabulary which is not [of Al]gonkin origin to its source in the language [of] some oth[illegible]ck. The religion of these tribes [illegible] plying [illegible] combined mythology and [illegible] resem[illegible] in the main A[illegible] inclu[illegible] source. [illegible] attribute[illegible] (*Apistotok*[illegible] fied with the [illegible] divinity of som[illegible] 'our father' [illegible] [illegible]*nnon*). [illegible] the same di[illegible] invocations it is designated by the same name, *Natōs*. Yet it is often said to be the 'old woman,' the consort of the sun. The whole of this is confused enough in the minds of the Indians to render them unable to give, when questioned, exact explanations. As to the secondary creation, the Indian account runs: At a certain time all the earth was covered with water. The 'Old Man' (*Napiw*) was in a canoe, and he thought of causing the earth to come up from the abyss. He used the aid of four animals. The musk-rat dived, and remained so long under water that when he came to the surface he was fainting, but brought a little particle of earth between the toes of his paw. This particle the 'Old Man' blew into the size of the whole earth. It took him four days to complete his work. The 'Old Man' worked two days more to make the first woman, for after the first day's work he had not succeeded in making anything graceful." This Napiw, or "Old Man," adds Father Lacombe, "appears again in many other traditions and legendary accounts, in which he is associated with the various kinds of animals, speaking to them, making use of them, and especially cheating them, and playing every kind of trick. According to the account of the Indians, the "Old Man" came from the south-west, across the mountains; and after a prolonged sojourn in these countries he went toward the north-east, where he disappeared, and nobody has heard of him since. Those who have read Schoolcraft's "Algic Researches," Mr. Leland's "Algonquin Legends," and, above all, Dr. Brinton's "Myths of the New World," will recognise in Napiw the most genuine and characteristic of all the Algonkin divinities. In every tribe of this widespread family, from Nova Scotia to Virginia, and from the Delaware to the Rocky Mountains, he reappears under various names—Manabosho, Michabo, Wetuks, Glooskap, Wisaketjack, Napiw—but everywhere with the same traits and the same history. While these beliefs are all purely Algonkin, the chief religious ceremony of the Blackfoot tribes is certainly of foreign origin. This is the famous "sun-dance." That this ceremony is not properly Algonkin is clearly shown by the fact that among the tribes of that stock, with the sole exception of the Blackfoot and a few of the western Crees, it is unknown. Neither the Ojibways of the lakes nor any of the numerous tribes east of the Mississippi had in their worship a trace of this extraordinary rite. The form of government among the Blackfeet, as among the Algonkin tribes generally, is exceedingly simple, offering a striking contrast to the elaborately complicated systems common among the nations of the Iroquois stock. Each tribe has a head-chief, and each band of which the tribe is composed has its subordinate chief; but the authority of these chiefs is little more than nominal. The office is not hereditary, the bravest or richest are commonly chosen; but in what manner the election is made is not stated. The term "confederacy" commonly applied to the union of the Blackfoot tribes is somewhat misleading. There is no regular league or constitution binding them together. "The tribes are separate," writes Mr. McLean, "and the bonds of union are the unity of religious belief, social customs, and language. They united against a common enemy, but I have never heard of their fighting against each other." Father Lacombe's account is similar. "The Blackfeet," he writes, "have no league or confederation, properly so-called, with councils and periodical reunions. They consider themselves as forming one family, whose three branches or bands are descended from three brothers. This bond of kinship is sufficient to preserve a good understanding among them." They can hardly be said to have a general name for the whole community, though they sometimes speak of themselves as *Sawketakix*, or "men of the plains," and occasionally as *Netsepoyè*, or "people who speak one language."

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## SECTION A.—MATHEMATICS AND PHYSICS

*Discussion on the Kinetic Theory of Gases.*—A most valuable and interesting discussion took place in this section on the kinetic theory. As at present applied the theory gives a much larger ratio for the specific heats of a gas than [illegible]eriment allows. And the more complex a gaseous molecule [illegible], the greater, according to theory, must be the ratio of [illegible] to its translational energy. The object of the dis[illegible] to determine whether the theoretical conclusions [illegible], or the experimental facts incorrectly observed. [illegible] the theoretical conclusions are not correct, [illegible]ded upon inadmissible assumptions; and [illegible] more thorough investigation.

Prof. Crum Brown opened the discussion upon lines already indicated in our present volume, p. 352. The ratio of the specific heat of mercury vapour at constant pressure to that at constant volume is 5/3. This gives, on the dynamical theory, only three degrees of freedom to the molecules: which must be the three translational freedoms. To prevent rotation, the molecules may be regarded as perfectly smooth, rigid, and spherical. But then the radiation cannot be accounted for. Similarly in diatomic gas the ratio is 7/5—giving three translational and two rotational freedoms; but again, not accounting for vibration of the atoms, either on the one hand, as parts of the molecules, or, on the other hand, in themselves.

Boltzmann's theorem asserts that the energy of a molecule is equally distributed amongst the different degrees of freedom. So if, in addition to the six degrees of freedom of a rigid body in space, the molecules have twenty or thirty others, it would seem that the dynamical theory must be abandoned, as there would not be sufficient energy for translational motion. The suggestion that radiation is caused not by vibration of the particles, but by disturbance of the ether due to the motion of the molecule through it, is scarcely admissible.

Difficulties again arise from the theoretical conclusion that energy of each kind is distributed among the molecules according to some form of the law of probability. For them, in a mixture of gases, we should always have some molecules in a condition favourable for combination. Also there should be no such sharp temperature and pressure limits for combination as exist—*e.g.* in the case of phosphorus and oxygen. Hydrogen and oxygen can be kept very long at a temperature near that of combination, without any chemical action occurring.

Prof. G. D. Liveing, in a paper on kinetic theory, said that the first doctrine leading to difficulties arises from assumptions, and is not a necessary part of the theory. The final distribution is the result not only of circumstances which vary, but of laws of force which are determinate. So there will be a tendency finally to limitation of the distribution of the energy in the different degrees of freedom. The dissipation of energy is the result of such laws limiting the reversibility of transmutations. Boltzmann's result will *not* follow if we consider other laws in addition to the conservation of energy. Indeed, the probability for it would be *nil*. Boltzmann also does not distinguish different kinds of motion—such as those of liquefaction, vaporisation, and dissociation. Those of translation and vibration even are often classed together. Yet the former three take place only after a certain accumulation of energy in the system; and the same may be true of the different vibrational degrees of freedom.

The constancy of the specific heats of some gases for large ranges of temperature indicates a constant *proportional* distribution of energy among the different degrees of freedom. But the proportion need not be that of equality. It is quite possible that mercury vapour at those temperatures at which its specific heat has been measured has no sensible vibrational energy. Experiments upon the emissivity of the more perfect gases show that they have, at ordinary temperatures, much less vibrational than translational energy; so that they may have only one, or, at most, two modes of vibration. The theoretical relation between the number of degrees of freedom in gases and their specific heats possibly requires revision. Still, it only limits the number of degrees sensibly exercised at the temperatures at which the specific heats were measured.

As regards the distribution of energy amongst the molecules, it is almost impossible to evade the conclusion that great differences of motion will exist, even although no particular law of distribution be assumed. Still, it is quite possible that there may be laws regulating the actions in encounters which prevent the excessive accumulation of any one kind of motion. Again, some molecules at 100° may have the average translational motion of molecules at 600°, but not that of vibration. So that very few molecules may have, at the same time, excess of motion of both kinds. Further, since this excess of energy is acquired at the expense of neighbouring molecules, the probability of there being at the same place two atoms of hydrogen and one of oxygen, in a mixture of these gases, in the average condition of those at the higher temperature, is infinitesimal. And yet again degrees of freedom exercised at the higher temperature alone may never be exercised by any molecule at the lower temperature on the average.

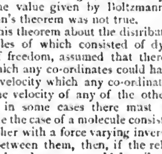
Differences of pressure in the two masses of the same gas at the same temperature are on the dynamical theory only differences of average free paths, so that it is difficult to imagine how any of the molecules in the more compressed gas can be said to be in the state, as to pressure, of the average molecules in the less dense gas. The free path of a molecule of the denser gas may at any instant be the same as the average free path of the molecules of the less dense gas; but its *average* free path will not be the same as theirs, and it is this that determines the pressure. In a system consisting of phosphorus and oxygen the possibility of chemical combination implies the possibility of an atom of phosphorus acquiring the same motion of translation, both as to speed and direction, as several atoms of oxygen, and of their jointly taking up the vibrational motions proper to an oxide of phosphorus at the temperature of the system, and that the transformations of energy involved in all this should be attended on the whole with a degradation. Since a diminution of the pressure of a gas means a degradation of its energy, this may facilitate combination when the mere fact of the molecules having instantaneous free paths of greater or less length would not suffice to produce such a result.

Sir W. Thomson remarked that Boltzmann's theorem was true in one particular case, but a proof of this case could be arrived at without the aid of the theorem, so that this does not prove the truth of the theorem. On the other hand, he had never seen any reason for believing in it at all. If we take an absolutely elastic globe and cause it to rebound between two parallel absolutely smooth and hard planes in a region where gravity does not act, it will go on moving between the two. But he does not believe that this will continue for ever. The translational energy of the ball will get transformed into energy of higher and higher modes of vibration, so that at last the ball will come to rest, as it will be impossible for this energy to be retransformed into translational energy.

Prof. J. J. Thomson said that he thought the reason that the ratio of the specific heats of a gas, as found by experiment, did not agree with the value given by Boltzmann's theorem, was because Boltzmann's theorem was not true.

Boltzmann, in his theorem about the distribution of energy in a gas the molecules of which consisted of dynamical systems with *n* degrees of freedom, assumed that there were no limits to the velocity which any co-ordinates could have, and therefore that the limiting velocity which any co-ordinate could have was independent of the velocity of any of the others. Now it was easy to see that in some cases there must be limits to the velocities, for, take the case of a molecule consisting of two atoms attracting each other with a force varying inversely as the square of the distance between them, then, if the relative velocity exceeded a certain value, the atoms would describe hyperbolas about their common centre of gravity, and the distance between them would increase indefinitely—in other words, the molecule would break up. Again, if we considered the case of a series of balls connected together by springs and fastened to a system which vibrated much more quickly than the natural period of vibration of the balls, then, if all the impacts fell on this system, the dynamics of the case, as investigated by Stokes and Sir William Thomson, showed that any disturbance would not be equally distributed among the balls, but that the energy in the balls would diminish in geometrical progression as we went away from the system at the end. It seemed, to say the least, rash in a case of this kind to assume that the velocity of any of the balls far away from the system was independent of those preceding it.

He had devised a molecule which it was easy to see would not obey Boltzmann's theorem. A was an envelope to the




bottom of which a feeble spring was fixed, the other end of which was attached to a heavy weight, B. To this weight a strong spring was attached, to the other end of which a light weight, C, was fixed. A rod of small mass was fastened to C, of such a length that it only extended beyond the envelope when the springs were stretched. This system would have two periods of vibration—a quick one corresponding to the upper sphere, and a slow one corresponding to the lower one. Then if all the molecules were stated, so that the amplitude of the quick vibration of C was much greater than the slow one, it was easy to see that the mean energy of the upper sphere would be greater than the mean energy of the lower ones, while, according to Boltzmann's theorem, these two quantities ought to be the same.

It might be mentioned that any co-ordinate which only entered the expression for the energy through its differential coefficient could be eliminated from the expression occurring in Boltzmann's theorem and the method applied to the remaining co-ordinates, so that, even if Boltzmann's method was unobjectionable the result need not apply to co-ordinates of this kind.

With regard to the second of the difficulties mentioned by Prof. Crum Brown, he thought that the point raised presented no difficulty if we took Williamson and Clausius's view of chemical combination. According to this view it was necessary to consider the number of molecules dissociated as well as the condition of the molecules; and though, if we took two gases at any temperature, it was true that there were a finite number of their molecules whose energy did not differ much from the mean energy of the molecules at the temperature at which they combined, yet it did not follow that a finite proportion of these were dissociated, and if there were not we could not expect them to combine. If the collision between two molecules in nearly the same condition was more efficacious in splitting up the molecules into atoms than a collision between molecules in widely different conditions, then we should not expect a finite proportion of the molecules in any state widely different from the mean to be dissociated.

Prof. W. M. Hicks said that one of the greatest objections to Boltzmann's theorem appeared to him to be the difficulty in believing that the mean energy of any vibration whatever of an atom was susceptible of unlimited increase, and referred to the case of a vortex ring inside a rigid spherical shell, where such energy could not be made to exceed a particular limit. As a matter of fact it was not proved that Boltzmann's theorem must correspond to the actual state, but only that an arrangement given by his theorem, if a possible one, was a permanent one. He stated that if the momenta could not exceed definite limits, Watson's proof could easily be modified to show that the energy was not distributed equally amongst the degrees of freedom. On the other hand, it was not permissible to assume all momenta consistent with the equation of energy as existent. As an example the case of a system of mutually attracting spheres might be taken. Here the equation would admit of the infinite velocities due to infinitely near approach of the centres, which would in the actual case be prevented by the finite size of the spheres. Further, any particular system might possess other integrals of the equations of motion, which would introduce further limitations.

Prof. Osborne Reynolds remarked that the kinetic theory is only supposed to be true in as far as the assumptions on which it was based represented the actual circumstances. In these assumptions no account whatever was taken of any resistance to which the molecules in their motions might be subjected, other than that which arose from the mutual encounters. Whereas it was perfectly well known and certain that there must be such resistances connected with the radiation of heat—these resistances, applying only to motions of certain character, *i.e.* to the vibratory motions, whatever these may be. Neglecting these resistances, the kinetic theory points to the conclusion that the mean energy in each one of these vibratory motions would be the same as in each one of the translatory motions. In the same way, neglecting resistance, a pendulum continuously struck at varying intervals with a hammer of a given weight and moving at a given speed would possess the same mean energy whether the intervals were to be measured by years or seconds. But experience at once showed that with friction, the shorter the interval between the blows and the smaller the friction, the greater would be the mean energy of the pendulum. So, taking resistance into account, it would follow from the kinetic theory that the mean energy in the so-called degrees of freedom would be greatest in those in which the diffusion of energy was greatest and the resistance least, while it would be least in those in which the rate of communication was least and the resistance greatest. Hence, in any gas, the mean energies of translation, in which there is most rapid communication and no appreciable resistance, will be much greater than the mean energies of vibration to which there is all the resistance consequent on the radiation, and in all probability but little communication.

The same answer applies to difficulties raised as to the distribution of motion. The assumed distributions leave out of consideration all resistances, and resistance, however slight, would cut off the extreme velocities.

Mr. H. B. Dixon said that, by a series of observations made on a mixture of oxygen and hydrogen at intervals of 1000 hours, he had obtained evidence of combination at temperatures below that of dissociation.

*Constant Gravitational Instruments.* — Sir W. Thomson showed and explained constant gravitational instruments for measuring electric currents and potentials. In one instrument for measuring currents he employs the principle that a mass of soft iron of dimensions and shape not differing too much from a sphere, experiences, in a field of magnetic force, a pull from a place of weaker to a place of stronger force. The variation of the field is produced by variation in the dimensions of the conductor through which the current passes. In an instrument for measuring high potentials he used one pair of opposite quadrants placed vertically. The quadrants are connected to one pole of the instrument whose potential is required, and the needle, the lower end of which can be weighted, is joined to the other pole.

*On the Dilatancy of Media composed of Rigid Particles in Contact*, by Prof. Osborne Reynolds.—In the account which Prof. Reynolds gave of his paper, he did not submit a complete dynamical theory, but discussed a very fundamental property of granular masses. To this property he gives the name of *dilatancy*. It is exhibited in any arrangement of particles where change of bulk is dependent upon change of shape. In the case of fluid matter, as we know it, change of shape and volume are independent. In solids they are sometimes not separable. With granular masses the result is different—change of shape *always* produces change of volume. And further, in every case, f change of volume is prevented any change of form is impossible.

If we suppose the component granules to be spherical, no granle can change its position without disturbing the adjacent ones -for the granules are all supposed to be perfectly rigid, and to e absolutely in contact—and the internal particles are fixed if e external ones are. In illustration Prof. Reynolds showed a odel of connected spherical bodies arranged in crystalline rm. This model showed the arrangement of the particles rresponding to (say) the condition of least possible density of e whole mass (about one-half the density of the separate heres). The shape could then be altered to that which corsponds to maximum density—the change taking place by ding of the particles one upon another. Between the extreme tes there are intermediate stages of equilibrium corresponding maximum-minimum positions, where alteration in one direcn produces decrease of density, and in the other increase of nsity.

n a complete treatment of the problem, friction must be ely considered; but in the experiment shown it is not of sequence, the result being independent. The above states will be true of any continuous mass of granules if we hold boundaries.

his principle of the dilatancy of such granular media ains many phenomena of common occurrence. For example, a sack of corn; if set on end, it remains perfectly flexible, f placed on its side it becomes hard, and its shape will not . Now take an indiarubber sack, fill it with corn—it ins perfectly flexible in all positions. The reason for this ence of behaviour is that in the former case the boundary e granular mass is inextensible, while in the latter it allows se of internal volume. So if it be possible with an sible envelope, to impose a maximum volume upon the nts, effects similar to those obtained with the inextensible lary may be expected: and this can be done. If we place shot (No. 6 was used in the experiment) in a thin india- bag, and add a certain amount of water, we obtain the wished. For if the amount of water added be such that ces between the granules when in close arrangement are d by it, while with a wide arrangement the amount is not , a point will be reached in passing from the first to the arrangement such that any further change of shape, and ently of volume, would produce a vacuum. When this reached the whole mass becomes perfectly hard. Prof. Reynolds illustrated this in a very beautiful manner by means of a ball of shot to which a glass tube open at the end was fitted. With a close arrangement of the shot, the water, which was coloured, stood high in the tube; but when pressure was applied to the bag, the level was lowered. This was shown also by the lecturer with a ball containing sand instead of shot. The water level sank till the whole was at maximum density, and, still more pressure being applied, the level again rose, the maximum having been passed. In these experiments about 6 per cent. of the water was free at the top of the ball with the close arrangement of granules. When another ball containing 20 per cent. of free water was used, the hard condition could only be approximated to by pressure, and then passed. So long as the maximum is not passed in this case the ball springs back to its original state when the pressure is released. But if the maximum be passed, it will not spring back. If some of the water be now let out, the maximum cannot be passed, except by shaking, and, if the flattened ball be then turned on edge, it will bear a pressure of a hundredweight without change of shape.

When the dilatant material, such as shot or sand, is bounded by smooth surfaces, the layer of grains adjacent to the surface is in a condition differing from that of the grains within the mass. This layer can slide between the one succeeding it and the surface, so that its displacement will cause much less dilatation than would be caused by the sliding of a layer within the mass. Hence, if two parts of the mass are connected by such a surface, certain conditions of strain may be accommodated by a streaming motion of the grains next the surface. Thus, if into a glass funnel partially filled with shot and held in a vertical position more shot be forced from below, the particles will flow up all around the sides—not rising in the centre as might have been thought.

As the foot presses upon the sand, when the falling tide leaves it firm, that portion of it immediately surrounding the foot becomes momentarily dry. When this happens the sand is filled, completely up to its surface, with water raised by capillary attraction. The pressure of the foot causes dilatation of the sand, and so more water is required. This has to be obtained either by depressing its level against the attraction or by drawing it through the interstices of the surrounding sand. As this latter requires time, for the moment the capillary forces are overcome, and the surface of the water is lowered below that of the sand, leaving it dry until a sufficient supply has been obtained from below, when it again becomes wet. On raising the foot we generally see that the sand under and around it becomes wet for a little time. This is because the sand contracts when the distorting forces are removed, and the excess of water escapes at the surface.

In referring to the results which might be expected to follow from a recognition of the property of dilatancy the author said that it places a hitherto unknown mechanical contrivance at the command of those who would explain the fundamental arrangement of the universe, and one which seems to promise great things besides possessing the inherent advantage of great simplicity. He then proceeded to explain, in a general way, how bodies in such a medium would—in virtue of the dilation caused in the medium—attract each other at a distance, with a force depending on the distance, which might well correspond with the force of gravitation. Further, owing to the existence of a region close to the body in which the density varies several times from maximum to minimum, the mutual force might undergo a change from attraction to repulsion, and this more than once as the bodies approach—a condition which seems to account for cohesion and observed molecular force far better than any previous hypothesis.

The transmission of distortional waves becomes possible if the medium be composed of small grains with large grains interspersed. The separation of two such sets of grains leads to phenomena closely resembling the phenomena of statical electricity. The susceptibility of such a medium for a state in which the two sets of grains are in conditions of opposite distortions may explain electrodynamic and magnetic phenomena, while the observed conducting power of a continuous surface for the grains of a simple dilatant medium closely resembles the conduction of electricity.

In remarking upon Prof. Reynolds's paper Sir W. Thomson pointed out an interesting question. Take a cube of spheres in the condition of maximum volume, and let every sphere touching the boundary be glued to it to prevent slipping. Other states are possible in the interior, but can we pass *continuously* to another condition, the boundary being held firm? Prof. Reynolds replied that he believed that he had got the result that it could not be done if we have a continuous medium. As other problems for solution, Sir W. Thomson suggested the theory of the hour-glass—what fixes the constant time for the sand running? and why does a substance sink deeper in a quicksand than in a viscous fluid of the same density?

*On Calculating the Surface-Tensions of Liquids by means of Cylindrical Drops or Bubbles*, by Prof. Pirie.—There are two methods by which the surface-tension of liquids are calculated. One involves the measurement of the height to which the liquid rises in a cylindrical tube of known diameter. The other involves the measurement of the height of a certain point of a drop of the liquid above a flat surface upon which it is placed. This point is the point of contact of the tangent plane when it becomes vertical. The former method is objectionable, because the results might be vitiated by the presence of a very small quantity of grease in the tube, or by electrification, &c. The latter, too, is not in a satisfactory state. Gay Lussac's results were in no degree different from those obtained by the ordinary method. Quincke's measurements are good, but his mathematics are misleading. To obviate the mathematical difficulties the author makes use of long drops—that is, drops obtained by placing portions of the liquid upon a concave cylindrical surface. The advantage is that the differential equation used in the calculation is immediately integrable. In remarking upon this paper Prof. Stokes said that Worthington has shown, by extending Quincke's result, that the theory agrees with experiment.

*On the Surface-Tension of Water which contains a Gas dissolved in it*, by Prof. Pirie.—This question is important, for no liquid is usually free from gas in solution. Prof. Pirie finds that the surface-tension is unaltered so long as the specific gravity of the water is unaffected by the dissolved gas. It is strongest in the pure liquid.

*On the Thermodynamic efficiency of Thermopiles*, by Lord Rayleigh.—The question has often arisen whether or not the dynamo may be replaced by an arrangement of thermopiles. There is a great difficulty due to the conduction of heat. Let $t$ and $t_0$ be the temperature of the hot and cold junctions; $e$ the electromotive force of one pair per degree Centigrade, and $E$ the total E.M.F., hence we have

$$ne(t - t_0) = E.$$

From this equation the author obtains by means of Joule's law the expression

$$\frac{n^2 e^2 (t - t_0)^2}{4 R_0}$$

for the useful work done externally. And again, if $r_1, r_2, \sigma_1, \sigma_2$, represent the specific electric resistance and the cross-sectional area of the metal bars, while $l$ is their length,

$$R_0 = nl\left(\frac{r_1}{\sigma_1} + \frac{r_2}{\sigma_2}\right).$$

To obtain the efficiency the above work must be compared with that done by the apparatus regarded as a perfect heat engine working between the same temperature. The ratio is

$$\frac{4J}{te^2}\left(\frac{r_1}{\sigma_1} + \frac{r_2}{\sigma_2}\right)\left(\frac{\sigma_1}{r'_1} + \frac{\sigma_2}{r'_2}\right).$$

where $r'_1$, $r'_2$ are the specific thermal resistances. The efficiency therefore is independent of $(t - t_0)$, of $n$, and of $l$, and also of the *absolute* values of $\sigma_1$, $\sigma_2$, $r_1$, $r'_1$, $r_2$, and $r'_2$.

Putting in numerical values for a thermopile of iron and German silver, Lord Rayleigh got 300 as the value of the above ratio. Since $e^2$ is involved, this number may be somewhat reduced; but high values of $e$ are usually associated with high internal resistance. There is therefore no possibility of the thermopile becoming a useful generator of electricity on a large scale.

*On Molecular Distances in Galvanic Polarisation*, by Mr. J. Larmor.—Mr. Larmor's method involves the electro-chemical equivalent of the liquid used, and so differs from the two methods previously adopted. He has obtained extremely accordant results.

*Cooling of Wires in Air and Vacuum*, by Mr. J. T. Bottomley.—Mr. Bottomley finds that the medium has a most marked cooling effect. An electric current passed through a wire, when surrounded by air at atmospheric pressure, heated it only to 80° C. But when the air-pressure was $\frac{1}{19(10)^6}$ of an atmosphere, the wire became red hot. The temperature did not alter much until the pressure became 1-100th of an atmosphere.

*An Account of Levelling Operations of the Great Trigonometrical Survey of India*, by Major A. W. Baird.—This paper opened with an account of the methods formerly used in the determinations of relative height by the survey. The errors affecting these methods and the means adopted for their elimination were then pointed out. Various lines of level carried to connect tidal stations lying north and south indicated a difference of sea-level at the stations. This difference cannot be due to false levelling of the instruments produced in consequence of the illumination of the spirit-level by the sun, for the same end of the line was not always brought out highest, and along one line no difference of level was perceptible. The discrepancy in one case amounted to three feet along the line from Bombay to Madras. The two weakest parts of this line were re-levelled, giving the same results as before. Consequently it would seem that the error is caused by local attractions influencing the instruments in greater degree than the more distant ocean.

*On the Rainfall of the British Islands*, by Mr. A. Buchan.—Mr. Buchan pointed out that the greatest differences in climates arise from differences in the rainfall. For example, the mean temperatures of Skye and the Moray Firth coasts in any month are not much different, but the rainfall in Skye is about four times that at the Moray Firth. The former is one of the latest and poorest grain-producing districts in Scotland, and the latter is just the reverse. The inquiry was based on observations of rainfall made at 1080 stations in England and Wales, 547 in Scotland, and 213 in Ireland. They extend from the year 1860 to the year 1883. The regions of heaviest rainfall, giving an average of 80 inches or upwards annually, were the Skye and a large portion of the mainland to the south-east as far as Luss, on Loch Lomond; the greater part of the Lake District; a long strip, including the more mountainous parts of North Wales; and the mountainous district in the south-east of Wales. The West Highlands is the most extensive region of heavy rainfall in the British Islands. Its mountainous coast faces the rain-bringing winds of the Atlantic, and the air, being cooled in its passage up the lochs and valleys, the moisture is precipitated. At Glencoe, in this district, the heaviest rainfall in Scotland occurred—128·5 inches. The smallest rainfall is in a large portion of the south-east of England. The average rainfall for the last half of the period from 1860 to 1883 was comparatively high, chiefly in the eastern districts.

*On a Remarkable Occurrence during the Thunderstorm, August 6, 1885*, by Mr. W. H. Preece.—A house at St. Cuthbert's, ten miles from Wolverhampton, is connected with the town by telephone, and is also lighted by electricity. The dining-room was lighted by a single lamp in multiple arc with some others. The telephone wire was connected to the lightning-conductor as an earth. When the storm occurred, the dining-room lamp flashed up and went out, while a loud report was heard. The lightning-rod made bad earth, and it is believed that it had been struck, and that part of the discharge had entered the telephone circuit and then sparked across to the electric-light circuit. It did not seem to have divided, but to have passed entirely along the one branch, including the dining-room light, the platinum wire of which was volatilised and deposited on the interior of the glass, forming a good mirror.

*Meteorology of Ben Nevis*, by Mr. A. Buchan.—Mr. Buchan remarked that Ben Nevis possesses great advantages as a meteorological station because of its great height and its summit being only about four miles horizontally distant from a sea-level station. Also it is in the track of the Atlantic storms, which exercise so great an effect on the weather of Europe, especially in autumn and winter. The observations made on the mountain are for the purpose of determining more fully the great movements of the atmosphere and the dependence of the weather upon them. Mr. Buchan called attention to the great importance of abnormal values in the thermometric and hygrometric observations especially. The recurring periods of ... characteristic of Ben Nevis do not occur at lower stations. The *föhn* peculiar to [illegible] and occurs on Ben Nevis, and is always associat[illegible] rainfall in the neighbourhood. When a cycle[illegible] foot of the mountain there is an anticyclo[illegible]

*On some* [illegible] *Temperature* [illegible]

Courtenay Fox.—The laws enunciated in this paper are deduced empirically from observations extending over the last seventy years. Even as detached laws they are of great value; but their importance is more evident when we consider that, as the author remarks, it is from such material that the future science of meteorology must be built up by cautious induction. Given that a certain month of season is in certain condition as regards temperature or rainfall, Dr. Fox seeks to determine what may be predicted of the succeeding period as regards these qualities. He finds that, if a spring or a summer be very cold, the succeeding season will be cold; and warm autumns succeed very warm summers. The fact of a very dry August being followed by a wet September is unique. The following table shows other results obtained.

| Characteristics. | Month. | Month following. |
| --- | --- | --- |
| Very cold | Jan., April, June, July, Aug., Sept., Dec. | Cold |
| Very warm | Jan. | Dry |
| | June, July, Aug., | Warm |
| Very dry | June, July, | Warm |
| Very wet | Jan., March, April, | Warm |
| | May, July | Cold |

In addition the author records what follows when a given ıth has marked temperature and moisture characteristics ıultaneously.

| Characteristics | Month | Month following |
| --- | --- | --- |
| Varm and wet | Nov., Dec., | Wet |
| | Jan., | Warm |
| /arm and dry | June, July, | Warm |
| | Aug., | Wet |
| old and wet | July, Aug., | Cold |
| :old and dry | Dec., | Cold |
| | Nov. | Dry |

very cold and very wet summer is succeeded usually by a autumn

*mestic Electric Lighting*, by W. H. Preece, F.R.S. Elecn G.P.O.—After referring to the full details of the lighting lation of his house in Wimbledon, given to the section at neeting at Montreal, Mr. Preece referred generally to the iences he had gained during the past twelve months. The lary batteries upon which he had mainly relied exceeded pectations in the services they rendered. They returned cent. of the energy put into them without any apparent ıtion whatever in their E.M.F. They showed no signs of ration and gave no trouble whatever. He used his gas for charging only two days a week. He had experienced lt with the wiring of his house. He had used only the st materials, and had attended personally to the insulation system. It was periodically tested and found to be good. erred in severe terms to the cheap and nasty wire which frequently and ignorantly used, and feared that the prejuainst the electric light would increase when failures from ise arose. None but the very best materials should be d the joints should be seen to by experts. He had densiderable attention to the problem of distributing light, l succeeded so far that while his rooms were beautifully ted the eye was not irritated by regarding a bright source . The lamp he used was a 50 volt 10 candle power glow d it was, as a rule, so fixed that the eye never saw it. arrived at the use of these lamps after careful considera- l many trials of other lamps. They secured greater the leads, and involved less capital in batteries through of low E.M.F. He ran his lamp at an E.M.F. about t. less than the normal E.M.F. He did this to secure to his lamps. The breakage had been very small. The and current which will give a lamp a normal life of ırs and a certain candle power should be determined by ker. The sixth power of the current will give the wer and the twenty-fifth power the life with any other The great advantage of batteries is that the proper curdetermined can never be exceeded, and thus efficiency is ensured. If lamps are run too low there is a waste of power, if too high there is a waste of lamps. We are now gradually acquiring a thorough knowledge of the number of Watts which should be expended in each lamp to secure the maximum economic efficiency. He had introduced into the charging lead and into the discharging lead a Ferranti meter, so that he was able to record exactly the quantity of electricity passed through the batteries and that passed through the lamps. This beautiful meter is based on Ampere's laws which determine the attraction and repulsion of currents. A small phosphor-bronze vane is immersed in a bath of mercury, through which the current flows radially, fixed in a magnetic field. The mercury rotates and carries with it the vane. The rate of rotation varies directly with the strength of current and the number of rotations are recorded by a counter, which can be read off directly. So far he was perfectly satisfied with its performance. As regards expense, excepting the first cost, he did not find much addition to his expenditure for illumination. His electric light was costing him about 50*l.* a year for gas, wages, oil, and lamps. It was the cheapest luxury he indulged in. The great advantages were the comfort and cheerfulness it engendered, and as cheerfulness was the main element of health he thought that the electric light would prove a serious rival to the doctor. There was no one who valued health and comfort who should neglect to apply the electric light to his home, when it was brought, as it has been by the success of the secondary batteries, within his means. It was said that he, as an expert, could make things go which would fail in ordinary hands; but he mentioned several cases where coachmen, butlers, gardeners, and grooms had been found perfectly competent and intelligent enough to attend to everything.

*Discussion on Standards of White Light.*—This discussion was not so well sustained as the discussion on the kinetic theory. All the speakers agreed with the adoption of the pentane standard for commercial purposes. For scientific purposes a definition in terms of energy was deemed necessary. The eye cannot be used as an accurate instrument. On this point Prof. Stokes referred to the fact that if two equal areas differently coloured seem to have equally intense illumination, we have only to alter the size of the common area to destroy the apparent equality of intensity.

*On Photometry with the Pentane Standard*, by Mr. A. Vernon Harcourt.—Mr. Harcourt described the construction of the pentane standard light, and the method of using it for photometric purposes. In the course of his remarks he referred to the meaning of the expression "white light." Any so called standard of white light is more nearly a standard of yellow light. He had never got a satisfactory definition of the expression, but supposed it to be such light as we have in ordinary daylight.

*The Constitution of the Luminiferous Ether on the Vortex Atom Theory*, by Prof. W. M. Hicks.—The simple incompressible fluid necessary on the vortex atom theory is quite incapable of transmitting vibrations similar to those of light. The author has therefore considered the possibility of transmitting waves through a medium which consists of this fluid modified so as to contain small vortex rings closely packed together. The rings are supposed to be composed of the same material as the rest of the fluid, to be very small compared with the wave-length, and to be at distances from one another also small compared with the wave-length. Their motion of translation is also taken to be so comparatively slow, that very many waves can pass over any one before it has much changed its position. Such a medium would probably act as a fluid for large motions. The vibration in the wave front may be (1) swinging, such as a ring oscillating on a diameter; (2) transversal vibration of the ring; (3) vibrations perpendicular to the plane of the rings; (4) apertural vibrations. Of these (3) seems to be impossible. If $r$ be the radius of the rings, $l$ the distances of their planes, $w$ their cyclic constant, and $v$ the velocity of translation, the author found

$$\text{For (1)} \ldots\ldots \quad v \propto \frac{w}{l}\left(\frac{r}{l}\right)^4.$$

$$\text{For (2)} \ldots\ldots \quad v \propto \frac{w}{l}\left(\frac{r}{l}\right)^2.$$

whilst for (4) in case of rings arranged parallel to a wave-front—

$$v \propto \frac{wr^2l^2}{(l^2 + 4r^2)^{\frac{5}{2}}}$$

*On a Photometer made with Translucent Prisms*, by Mr. J. Joly.—In this photometer each side of the prism is illuminated by one of the lights to be compared, the edge being turned to the observer. The great advantage here is that the two illuminated parts are placed in sharp juxtaposition.

*On a Point in the Theory of Double Refraction*, by R. T. Glazebrook.—The author suggested that the theory of double refraction given by Lord Rayleigh, in which the ether is supposed to have an effective density different in different directions, might be modified so as to agree with Fresnel's theory, if it be not necessary to assume that the ether offers an infinite resistance to compression, but only that, as compared with its rigidity, its compressibility is very great, and further that in a crystal the light vibrations are normal to the ray, not to the wave normal, as was pointed out by Boussinesq and referred to by Ketteler in some of his papers.

*On a New and Simple Form of Calorimeter*, by Prof. W. F. Barrett.—The bulb of a thermometer is made in the shape of a double cup. In this cup is placed the substance whose specific heat (say) is to be determined. The stem of the thermometer is horizontal, and rests on a fulcrum so that the weight of the substance may be determined by using the apparatus as a balance. Special precautions are taken in determining the temperature of the substance when placed in the cup, and to prevent evaporation, &c. The specific heat is then given by the ordinary equation,

$$WS(T - \theta) = C(\theta - t),$$

the constant $C$ being determined by experiment once for all.

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## Section B—Chemistry

*On the Non-Existence of Gaseous Nitrogen Trioxide*, by Prof. Ramsay.—After pointing out the inconclusive character of Lunge's argument in support of the existence of gaseous nitrogen trioxide, inasmuch as the use of any reagent may either decompose the gas or react with the products of its dissociation—viz. NO and $N_2O_4(NO_2)$, as though they consisted of $N_2O_3$ itself, the author shows the only criterion of the existence of this gas to be its vapour density. He finds that $NO_2$ may be mixed with NO without effecting any change in volume, and therefore no combination, or only a very slow combination, can take place between these gases. The vapour density of the first portion of the gas obtained by distilling liquid $N_2O_3$ is found to be 22·35, a result which accords fairly well with what the density should be, supposing it to be a mixture of $N_2O_4$, $NO_2$, and NO, having the empirical composition $N_2O_3$. Supposing the gas weighed to contain no $N_2O_4$, an assumption not warranted by facts, and consist of NO and $NO_2$, then, in order to make the specific gravity 22·35, 17·63 per cent. of $N_2O_4$ must be added to the mixture. These facts the author considers as deciding the point against the existence of gaseous nitrogen trioxide.

*Observations on some Actions of a Grove's Gas Battery*, by Prof. Ramsay.—The action of an ordinary Grove's gas battery can be explained by supposing that, at the point of contact between the platinum, hydrogen, and liquid, a decomposition of the water molecule takes place, its oxygen uniting with the hydrogen gas to form water, whilst the hydrogen is liberated from molecule to molecule until the free gas arrives at the point of contact of the platinum, the oxygen, and liquid; here it unites with the oxygen gas, forming water. If the liquid in the battery be coloured with indigo sulphuric acid, the author finds the indigo in contact with the hydrogen to undergo no changes, whereas that in contact with the oxygen is discoloured, a change probably due to the oxidation of the indigo to isatine. Hydrogen, therefore, in uniting with oxygen, does not bleach indigo. Now if, in the ordinary gas battery, the acid be replaced by a saturated solution of sodium chloride and hydrogen, and chlorine be substituted for hydrogen and oxygen, the indigo is found to be bleached on both sides, the bleaching taking place from above downwards, and taking place at once on admitting the chlorine, but some time is required before the reduction by the hydrogen is evident. These experiments show that when hydrogen unites with chlorine it is in a more active state than when it unites with oxygen. To explain this difference the author suggests that, when a molecule of hydrogen unites with a molecule of chlorine, atomic hydrogen exists for a moment, and this, in presence of indigo, reduces it to indigo-white. In the case of hydrogen and oxygen the union of two molecules of the former with one molecule of the latter may be effected without the hydrogen assuming the atomic condition, whereas the oxygen must assume the atomic or nascent condition, to which the bleaching of the indigo may be ascribed; or it may ... ozone or hydrogen peroxide are formed. These phe... may, therefore, be regarded as chemical evidence confi... of the following method of expressing the union of these ... with one another:—

$$H_2 + Cl_2 = HCl + HCl. \qquad 2H_2 + O_2 = H_2O - H ...$$

*On the Spontaneous Polymerisation of Volatile Hydr... at the Ordinary Atmospheric Temperatures*, by Sir H. E. ... LL.D., F.R.S.—The attention of the author was drawn ... Staveley, of West Bromwich, to a camphor-like solid, ... from the more volatile liquid hydrocarbons, produce... composing crude phenol at a red heat. The change fr... liquid to the solid state was, at first, supposed to be du... influence of the oxygen of the air, but investigation ha... the solid to be a hydrocarbon having the formula $C_{10}H$... the change to be one of polymerisation. This s... carbon undergoes a further polymeric change when he... sealed tube at 180°. The author finds also that the first ... of ordinary coal tar, which distil below 30°, are, on ke... sealed tubes, converted spontaneously into this solid by ... $C_{10}H_{12}$.

*On some New Vanadium Compounds*, by J. T. Brierley.—... compounds described form a series of well-defined cr... salts of purple or dark green colour, possessing a meta... which contain both the oxides $V_2O_4$ and $V_2O_5$, an... regarded as vanadate-vanadites. These salts are fo... adding a caustic alkali to the dark green liquid ... adding hypovanadic sulphate to a solution of an alkali... vanadate. The composition of the sodium, potassi... ammonium salts are represented by the following fo... $2V_2O_4 . V_2O_5 . 2Na_2O + 13H_2O$ ., $2V_2O_4 . V_2O_5 2K_2O$ ... and $4V_2O_4 . 2V_2O_5 . (NH_4)_2O + 14H_2O$.

*The Essential Food of Plants*, by T. Jamieson, F... F.I.C.—Whilst no doubt exists as to the essential c... the elements of carbon, hydrogen, oxygen, and nitroge... stituents of the food of plants, the evidence in sup... elements phosphorus, potassium, magnesium, calcium ... iron, and chlorine to be regarded in this light cann... sidered conclusive. A little consideration shows ... elements, iron and chlorine, have but little claim to ... sidered as essential to the food of plants, and the ex... of which an account was given in this paper, were ma... author with the view of vindicating the right of the ... ing elements to be so considered. These investiga... conducted at an experimental station in Sussex and al... in Aberdeenshire, the nature of the soil in both cas... specially favourable. The method adopted consisted in ... ing the effects on plants grown in similar soil and unde... conditions, when supplied with manures, containing ... elements and comparing the results with those obtaine... one or other of these elements was withheld. These ex... seem to provide proof that sulphur must be discarded ... list of essentials, while some doubt is thrown on even ... magnesia. At the same time striking confirmation ... of the essential characters of both phosphorus and pota...

*A Plea for the Empiric Naming of Organic Compou...*, by Prof. Odling, M.A., F.R.S.—Verbal translations of th... tural formulæ assigned to organic compounds posses... advantages as names for the several compounds. Th... are applicable to all organic compounds of which the ... formulæ are made out; they are the only sort of name ... able to complex isomeric compounds; and their use can ... dispensed with wholly in the case of even less comple... pounds. Notwithstanding these advantages, structura... constitute unsuitable names for general use, more espe... applied to fundamental hydrocarbons, alcohols, and acids ... are objectionable for this use by reason of their lengt... plexity, and want of ready indicativeness; by the circu... of their being based on conceptions of chemical constitut... kind pointed out by experience as eminently liable to c... and by the further circumstance of their representing ... sided and, so far, an untruthful notion of the bodies des... Structural names, expressing other than a distorted view ... constitution of all but a few of the most simple of organic ... are impracticable by reason of their length and compl... Hence, to avoid the distortion inseparable from the use ... single structural name for an organic body, the only expedie... is the assignment to each body, in proportion to its complex... of an indefinite number ... ral names, a proceeding ...

tantamount to not assigning it any particular name at all. Although from their number and complexity, organic bodies can only be designated by names which do in some measure describe and characterise them, the primary purpose of a name is undoubtedly to designate, and not to describe. Accordingly, with a view to the prompt mental association of object with name, brief empiric names, based on the origin and properties of bodies, are, wherever practicable, to be preferred to structural names. As regards isomeric bodies, they may to a large extent be advantageously distinguished from one another by means of significant letters or syllables prefixed to the name common to the different isomers. But the suggested use of the particular letters α, β, γ, each in a special sense; also a general resort to the particles hydro-, oxi-, and hydroxi- as name-components; and, more especially, the innovation of substituting the word "hydroxide" for the long-established word "hydrate" are practices open to grave objection.

*The Periodic Law, as illustrated by certain Physical Properties of Organic Compounds*, by Prof. Thos. Carnelley, D.Sc.—In this paper the author shows that the physical properties of the normal halogen and alkyl compounds of the hydrocarbon radicals exhibit numerous relationships, which, with one exception, are similar to those which he has shown to exist between the normal halogen or the alkyl compounds of the elements. It appears that the physical properties of the following four classes of compounds obey the same rules:—(1) The halogen compounds of the elements—*i.e.* of elements with elements. (2) The alkyl compounds of the elements. (3) The halogen compounds of the hydrocarbon radicals. (4) The alkyl compounds of the hydrocarbon radicals—*i.e.* of hydrocarbon radicals with hydrocarbon radicals. The relationships referred to have been tested in no less than 6117 cases, 5 per cent. only of which are exceptions.

*Suggestions as to the Cause of the Periodic Law, and the Nature of the Chemical Elements*, by Prof. Thos. Carnelley, D.Sc.—The truth of the periodic law of the chemical elements is now generally allowed by most chemists. Nevertheless, but little has been done towards attaining a reasonable explanation of the law. The object of this paper, therefore, is to offer a few suggestions on this subject. Granting the truth of the periodic law, we cannot help theorising as to its cause, and thence by a natural step as to the nature of the elements themselves. Even long before the discovery of the law many chemists had pointed out certain numerical relationships existing between the atomic weights of bodies belonging to a given group, and had hence supposed that the elements belonging to the several natural groups were not primary, but were made up of two or more simpler elements. These conclusions, however, were more or less fragmentary, and referred only to particular groups of elements. In the light of the periodic law the author has made a general extension of the fragmentary conclusions of Dumas, and has brought that law into juxtaposition with an extended generalisation of the analogy of the elements with the hydrocarbon radicals. His conclusions are based on the relationships which he has observed to obtain between certain physical properties and the atomic weights of the elements, and those of their compounds (see previous paper). A careful consideration of the points submitted leads almost irresistibly to the conclusion that the elements are analogous to the hydrocarbon radicals in both form and function. This is a conclusion which, if true, would further lead us to infer that the elements are not elements in the strict sense of the term, but are built up of (at least) two primary elements, A (= carbon at. wt. 12), and B (ether at. wt. −2), which by their combination produce a series of compounds (viz. our present elements), which are analogous to the hydrocarbon radicals. If the above theory of the constitution of the elements be true, the periodic law would follow as a matter of course, and we should therefore be able to represent the elements by some such general formula as $_nB_{2n+(2-x)}$, analogous to that for the hydrocarbon radicals, $_nH_{2n+(2-x)}$, in which $n$ = the series, and $x$ the group to which the element or hydrocarbon radical belongs.[1] Assuming the truth of the theory here advanced, it is interesting to observe, that whereas the hydrocarbons are compounds of carbon and hydrogen, the chemical elements would be compounds of carbon with ether, the two sets of bodies being generated in an exactly analogous manner from their respective elements. There would hence be three primitive elements—viz., carbon, hydrogen, and ether. Finally, it may be stated that this theory would remove the chief objections which have been urged against the periodic law, whilst the existence of elements of identical atomic weights and isomeric with one another would be possible. May not Ni and Co, Ru and Rh, Os and Ir, and some of the rare earth metals be isomers in this sense?

[1] Cf. Abney's researches on the infra-red absorption spectra of carbon compounds (*Proc. Roy. Soc.*, 31, 416), also the article on the Decomposition of Didymium by Welsbach in NATURE, vol. xxvi. p. 435.

*The Value of the Refraction Goniometer in Chemical Work*, by Dr. J. H. Gladstone, F.R.S.—The principal points illustrated and enforced in this communication were (1) that the index of refraction and length of spectrum are important physical properties of any substance; (2) the specific refraction and specific dispersion may be serviceable: (*a*) in determining the purity of a substance, (*b*) in the analysis of such a mixture as ethyl and methyl alcohols, (*c*) as a guide in the investigation of organic compounds, (*d*) as arbiter between rival views as to the constitution and structure of particular chemical compounds.

*Refraction of Fluorine*, by G. Gladstone.—From a comparison of the observations on fluorspar, cryolite, and several artificial fluorine compounds, the author shows the refraction equivalent of fluorine to range from 0·3 to 0·8, the mean of the whole series of determination being 0·6. Thus, taking the highest estimate, the specific refraction of this element is scarcely equal to half that of any other substance.

*Note on the Conditions of the Development and of the Activity of Chlorophyll*, by Prof. Gilbert, LL.D., F.R.S.—An account of some experiments made in conjunction with Dr. W. J. Russell, which show a close connection to exist between the formation of chlorophyll and the amount of nitrogen assimilated by plants; the amount of carbon assimilated is not, however, in proportion to the chlorophyll formed, unless a sufficiency of mineral substances, required by the plants, is available. In cases where both nitrogenous and mineral manures were applied a lower proportion of nitrogen assimilated and chlorophyll formed over a given area was observed, which is no doubt due to the greater assimilation of carbon and consequent greater formation of non-nitrogenous substances, although the amounts of nitrogen assimilated and chlorophyll formed were as great, if not greater.

*On the Action of Sodium Alcoholates on Fumaric and Maleic Ethers*, by Prof. Purdie, Ph.D., B.Sc.—By the action of *sodium methylate* on *ethylic fumarate*, *methylic methoxysuccinate* is formed, from which *methoxysuccinic acid* can be obtained, a crystalline solid melting at 101°–103°; this same acid is obtained from the products of the reaction of sodium methylate on *ethylic maleate* or *hydric methylic maleate*. Similarly an *ethoxysuccinic acid* is obtained by the action of sodium ethylate on *ethylic fumarate*, also by its action on *hydric ethylic maleate*. Thus fumaric and maleic acids yield alkyloxy-succinic acids, which are identical with one another, or, if not identical, resemble one another so closely that their isomerism must be of the same character as that of substances which differ from one another only in their optical and crystallographic characters.

*On Sulphine Salts derived from Ethylene Sulphide*, by Orme Masson, M.A., D.Sc. (Edin.).—Ethylene sulphide, when heated at 160°, is converted into diethylene sulphide $S(C_2H_4)_2S$, an ethereal solution of which, when mixed with methyl iodide, unites with the latter to form *diethylene sulphide methyl sulphine iodide* $S(C_2H_4)_2S.CH_3I$, which is a crystalline compound soluble in water, but insoluble in alcohol or ether. From this compound a series of the *sulphine* salts have been prepared, which resemble the salts of trimethyl sulphine in their behaviour when heated, but differing from these compounds in the ease with which they are decomposed by caustic alkalis with the formation of *diethylene sulphide methyl sulphine hydroxide* $(C_2H_4)_2S_2CH_3OH$. The compounds obtained by Dehn (*Annalen*, Supp. iv. 83) by heating together ethyl sulphide, ethylene bromide, and water together in sealed tubes, and styled "sulphinic salts" by him, were, in all probability, dimethylene sulphine-methyl-sulphine derivatives.

*On an apparently new Hydrocarbon from Distilled Japanese Petroleum*, by Dr. Divers and T. Nakamura.—A description of a yellow solid hydrocarbon found amongst the final products of the distillation of the petroleum from the wells at Sagara. The hydrocarbon melts at 280°–285°, and has a composition expressed by the formula $(C_4H_3)_n$.

*The Composition of Water by Volume*, by Dr. A. Scott, M.A., D.Sc.—After pointing out the desirability of renewed determinations of the exact proportions in which hydrogen and oxygen combine with one another, inasmuch as neither of these gases obey Boyle's law exactly, the author gave a description of the apparatus he had employed in making such determinations, which allowed the use of considerable volumes of these gases. The results obtained show the ratio not to be exactly that of 1 vol. of oxygen to 2 vols. of hydrogen; but the proportions are 1 : 1·994 or 1 : 1·9935; or, if the impurity be supposed to exist in the oxygen alone, then the ratio is 1 : 1·996. The gases were examined as to their purity, the results indicating the presence of ·2 c.c. to ·3 c.c. of foreign gas in the 450 c.c. used.

In a communication entitled *On Solutions of Ozone and the Chemical Action of Liquid Oxygen*, Prof. Dewar gave a description of the apparatus and method employed by him in the liquefaction of such gases as oxygen, &c., and after discussing the conditions required for the successful conversion into the liquid state of the so-called permanent gases, he gave an account of some experiments made with liquid oxygen. At $-130°$ liquid oxygen loses the active characters possessed by this element in the gaseous state; it is without action on phosphorus, sodium, potassium, solid sulphuretted hydrogen, and solid hydriodic acid. Other substances appear to undergo similar changes at very low temperatures; thus liquid ethylene and solid bromine may be brought in contact without any action taking place, whereas gaseous ethylene and liquid bromine unite directly at the ordinary temperatures. Hautefeuille and Chapuis by subjecting a mixture of carbonic anhydride and ozone to great pressure obtained a blue liquid, the colour of which is due to the ozone. If ozonised air be passed into carbon disulphide at $-100°$, the liquid assumes a blue colour, which disappears if the temperature be allowed to rise, and at a certain point a decomposition, resulting in the production of sulphur, takes place. The best solvent for ozone is a mixture of silicon tetrafluoride and Russian petroleum. These solutions of ozone are without action on metallic mercury or silver. Prof. Dewar, in remarking on the liquefaction of nitric oxide, stated that a comparison of its curve of liquefaction with that of methane shows the pressure to increase more rapidly with the temperature in the case of nitric oxide than in other gases, a fact which would appear to indicate, that at low temperatures the molecule of nitric oxide is of greater complexity, and probably exists as $N_2O_2$. An account was given of some of Cailletet's experiments on the electrical conductivity at low temperatures, which seemed to indicate that as the limit $-220°$ was approached ordinary electrical conductors become almost perfect conductors.

*On the use of Sodium or other Soluble Aluminates for Softening and Purifying Hard and Impure Water, and Deodorising and Precipitating Sewage, Waste Water from Factories, &c.*, by F. Maxwell Lyte, F.C.S., F.I.C.—The advantages attending the use of sodium or other soluble aluminates for the above purposes are dependent upon their easy decomposition with the production of a precipitate of hydrated alumina, which removes organic matter, and further by their use the temporary hardness may be completely destroyed, and the permanent hardness reduced.

*Some New Crystallised Combinations of Copper, Zinc, and Iron Sulphates*, by J. Spiller, F.C.S.—The author gave an account of the preparation of a large series of double sulphates of copper and iron, zinc and iron, and copper and zinc.

In a communication on *Barium Sulphate as a Cementing Material for Sandstone* Prof. Clowes pointed out that, although Bischof mentioned instances of foreign sandstones in which the material cementing the sand grains together was barium sulphate, it appeared that up to the present time no such sandstone had been met with in the United Kingdom. Having learned that opinions differed regarding the calcareous nature of certain new red sandstone beds in the neighbourhood of Nottingham, he undertook to examine the chemical composition of these sandstones, and procured specimens of the sandstone from different levels. On being analysed, the sandstone was found to contain barium sulphate in varying proportions, at present being determined, while some of the lower beds also contained calcium carbonate. In some of the sandstone beds the barium sulphate was very unequally distributed, forming a network or a series of small masses more or less spherical in shape. In such sandstone the sand grains between the sulphate streaks and patches were quite loose, the result being that the weathered surface presented a honeycombed appearance. To explain the presence of the barium sulphate he suggested that it might have been deposited along with the sand; but if such had been the case it had certainly undergone a physical change, as it now existed in a firm, compact, and crystalline condition. It would, therefore, appear that it had been either deposited from aqueous solution or that it had been rendered crystalline by a slow percolation of a solvent liquid through the sedimentary deposit, or owed its origin to the action of water containing calcium sulphate passing through sandstone cemented originally with barium carbonate.

## NOTES

BOTANISTS will learn with very great regret of the death of Mr. Edmond Boissier, the learned and indefatigable author of the "Flora Orientalis," and many other important works on Systematic Botany. We have received no particulars, but we imagine his death must have been somewhat sudden, as the event was quite unexpected by his friends in this country. As recently as the month of August Prof. Oliver heard from him the communication relating to the Supplements to the "Flora Orientalis," on which the deceased botanist has been for some time engaged, and in which he wished to incorporate the botanical results of Dr. Aitchison's latest investigations in Afghanistan. Boissier's career as a botanist may be said to have commenced with his travels in Spain in 1837, when he collected the materials published in his "Voyage Botanique dans l'Espagne," a richly illustrated work which appeared at intervals from 1839 to 1845. He subsequently travelled and botanically explored various parts of South-eastern Europe and Asia Minor. Independently of his larger works he published, separately, diagnoses of the exceedingly large number of undescribed species he found from within the limits of the "Flora Orientalis," the first volume of which appeared in [illegible] and the last in 1881. This work alone is sufficient to place the author in the first rank of a school of distinguished systematists now alas fast disappearing without leaving a corresponding rising generation to take up the work where they have left it. Like the late Mr. Bentham, M. Boissier was in a position to give his undivided attention to the science he had chosen, and like him he laboured unceasingly; and it is to be hoped that the supplement to the "Flora Orientalis" is in a sufficiently forward state for publication. Among other things the [illegible] genus *Euphorbia* furnished materials for several valuable works, including a monograph of all the species, and a [illegible] volume containing figures of 120 species. Mr. Edmond Boissier was a Foreign Member of the Linnean Society, having been elected in 1860; and from his constant readiness to give others the benefit of his extensive knowledge, he enjoyed the esteem and admiration of a wide circle of botanists.

THE death is announced, at the age of seventy-eight years, of Mr. John Muirhead, one of the very few survivors of the early days of telegraphy, and closely connected with its practical development. Mr. Muirhead, in conjunction with Mr. Latimer Clark and Mr. W. M. Warden, of Birmingham, founded the house now known as Latimer Clark, Muirhead, and Co., more than a quarter of a century ago. It was from this manufactory that Mr. Muirhead introduced the form of battery which bears his name, a form so eminently portable and practical that it has become the model for most of the existing batteries, while continuing itself to be largely employed.

A *Times* telegram dated Philadelphia, September 27, states that the President of the United States has asked Prof. Alexander Agassiz to accept the post of Superintendent of the Coast Survey.

A REMARKABLE memoir on the development of the sternum in birds, prepared by Miss Beatrice Lind[illegible] and [illegible] to the Zoological S[illegible] H. [illegible] meeting on June 16 [illegible] after close investigation of the embryonic condition of different stages in five types of bird-structure (the ostrich, guillemot, gull, domestic fowl, and gannet), has come to the conclusion that the keel of carinate birds is a special outgrowth of the true sternum peculiar to birds, and is not homologous with the episternum or interclavicle of reptiles, as has been held by Götte and others. There are no traces whatever in the embryonic stages of the ostrich, according to Miss Lindsay's observations, of the existence of any rudiments of the clavicles or keel. It follows that he view held by some morphologists that the ostrich may be a legraded descendant of some carinate form can no longer be upported.

THE Edinburgh International Industrial Exhibition will be pened on May 4 next.

A CORRESPONDENT of the *Times* in a recent article on the :w Electorate, describes the fishermen at Staiths, a village on e Yorkshire coast, lying between Whitby and Saltburn. The ople, he says, are imbued with all manner of quaint supertions. They have a firm belief in witchcraft, the witch being iolly unconscious of his or her power of evil. Until recently— d it is said that the custom is still secretly maintained by some the older inhabitants—it was customary, when a smack or ole had had a protracted run of ill-fortune, for the wives of : crew and owners of the boat to assemble at midnight, and, deep silence, to slay a pigeon, whose heart they extracted, ck full of pins, and burned over a charcoal fire. While this ration was in process the unconscious witch would come to door, dragged thither unwittingly by the irresistible potency he charm, and the conspirators would then make her some pitiatory present. Again, it is of frequent occurrence that, r having caught nothing for many nights, the fishermen keep first fish that comes into the boat and burn it on their return ie as a sacrifice to the Fates. All four-footed animals are idered by the Staiths folk as unlucky, but the pig is the t ill-omened of quadrupeds. If when the men are putting · nets into the boats the name of pig is by accident men- :d, they will always desist from their task and turn to some r occupation, hoping thus to avert the evil omen, and in y cases will renounce the day's expedition altogether. The of a drowned dog or kitten, too, as he goes towards his : will always keep a Staiths fisherman at home; and, what ll more curious, if as he walks to his boat, his lines on his or a bundle of nets on his shoulder, he chances to meet o face with a woman, be she even his own wife or daughter, nsiders himself doomed to ill-luck. Thus, when a woman ι man approaching her under these circumstances she at turns her back on him. If a fisher sends his son to fetch g sea boots, the bearer must be careful to carry them under m. Should he by inadvertence place them on his shoulder her will inevitably refuse to put out to sea that day. An ; deemed so unlucky that the fishermen will not even use ord, but call it a roundabout; and, fearless as are the s in their daily struggling with the dangers of the sea, yet so l are they of nameless spirits and bogies that the writer ·ured he could not find in the whole fishing colony of ; a volunteer who for a couple of sovereigns would walk ht to the neighbouring village, a couple of miles distant.

have received the report of Miss Pogson, the meteoro- reporter to the Government of Madras, for the year 5. It contains remarks on the various stations scattered e Presidency, together with the usual tables. Part of the r's work is to train learners, who afterwards take charge ocal stations. One of these, it is interesting to notice, is Laccadives, which islands are inaccessible during a great the year. The assistants in most cases are native

ALL the legal steps have been taken by the French Government for entering into possession of the late M. Giffard's fortune, which is to be devoted to the good of science. The fortune is valued at 200,000*l*., after paying about 100,000*l*. in legacies to friends, family, or scientific societies. The decree is ready and will shortly appear in the *Journal Officiel*. Several projects have been proposed already for utilising this large sum of money, but it is very likely nothing will be done before taking the advice of the French Academy of Sciences.

ON September 12, just after sunset, a remarkable mirage was seen at Valla, in the province of Sudermania, Sweden. It appeared first as a great cloud-bank, stretching from south-west to north, which gradually separated, each cloud having the appearance of a monitor. In the course of five minutes one had changed to a great whale blowing a column of water into the air, and the other to a crocodile. From time to time the clouds took the appearance of various animals, and finally that of a small wood. Subsequently they changed to a pavilion, where people were dancing, the players being also clearly visible. Once again the spectacle changed, now into a lovely wooded island with buildings and parks. At about nine o'clock the clouds had disappeared, leaving the sky perfectly clear. The air was calm at the time of the display, the temperature being 6° C.

THE aquarium at the Inventions Exhibition has lately been entirely restocked, the latest arrivals being a fine selection of bass weighing 10 lbs., some large specimens of Crustaceans, and an assortment of flat-fish of all descriptions. There is also on view a diversified collection of foreign freshwater fish presented by the General Import Company.

CAPT. VIPAN's aquarium of foreign fishes at Stibbington Hall, Wansford, is a most valuable one, and includes unique and rare specimens of fish from all parts of the world, which are retained with the utmost care, the temperature of the water being regulated to suit the natural necessities of the various fish. This aquarium is considered to be one of the most unique in the United Kingdom, and increases in value annually on account of periodical additions to the collection.

THE taxidermist who has had charge of the work upon the body of "Jumbo," who was recently crushed between two trains, states that the elephant's stomach contained many English coins—gold as well as silver and bronze. His tusks had by the collision with the train been driven nearly through the skull. According to later accounts as to the accident, Jumbo at the last moment faced and charged the locomotive. The elephant's skin was found to be an inch and a half thick, and it weighed 1537 lbs. The skeleton weighs 2400 lbs., and the total weight of the body was over 6 tons.

MESSRS. SWAN SONNENSCHEIN AND CO. announce, for the season 1885-6, the following publications:—"A Treatise on Animal Biology," by Prof. Adam Sedgwick, Fellow and Lect. of Trin. Coll., Camb. (illustrated); "Practical Botany," by Prof. Hillhouse, of Mason Coll., Birm., based upon the work of Prof. Strasburger (largely illustrated); a translation of Profs. Nægeli and Schwendener's work, "The Microscope in Theory and Practice," with several hundred woodcuts; an "Alpine Flora," a pocket handbook for botanists and travellers, by Mr. A. W. Bennett, B.Sc., M.A.; an illustrated "Handbook of Mosses," by Mr. J. E. Bagnall; a "Star Atlas," by the Rev. T. H. Espin; further parts of Mr. Howard Hinton's "Scientific Romances"; an entirely new and partly re-written edition of Prof. Prantl and Vines's "Text-Book of Botany"; "From Paris to Pekin over Siberian Snows," an account of the Asiatic wanderings of M. Meignan, by Mr. William Conn; "The Wanderings of Plants and Animals," an adaptation from the German work of Prof. Victor Hehn, by Mr. James Stallybrass, tracing (chiefly by means of etymology) the history and the migration of European plants and animals to their home in Asia.

MESSRS. CROSBY LOCKWOOD AND CO. make the following announcements for the approaching publishing season:—"Electro-Deposition," by Alexander Watt, author of "Electro-Metallurgy"; "The Prospector's Handbook, a Guide for the Prospector and Traveller in Search of Metal-bearing or other valuable Minerals," by J. W. Anderson, M.A., F.R.G.S.; "The Engineman's Companion, a Practical Educator for Enginemen, Boiler Attendants, and Mechanics," by Michael Reynolds; "The Combined Number and Weight Calculator," by Wm. Chadwick, Public Accountant; "Our Temperaments, their Study and their Teaching, a Popular Outline," with illustrations, by F.R.C.S.E.; "The Artist's Tables of Pigments," by H. C. Standage; "Land and Marine Surveying," by W. Davis Haskoll (entirely new edition); "The Metal Turner's Handbook, a Practical Manual for Workers at the Foot Lathe," by Paul N. Hasluck (second edition, revised), being the first volume of a new series of "Handbooks on Handicrafts."

THE "Sun" Knife-cleaner has some points which deserve notice. It is supported on a light cast-iron standard, the upper portion of which is bored out and faced to make the bearing where alone perfect fit is required. A cast-iron spindle is fitted into this bearing, and supports upon a flattened face two spring disks made of cast steel finely tempered, dished in the centre and having rays upon them like the spokes of a wheel, which turn slightly outwards at their ends, so as to form a tapered space adapted to the wedge form of the length of the knife. These springs are so mounted upon the spindle that the rays of the one are opposite to the space, between the rays of the other. The spindle is terminated by a screw upon which a thumb nut is fixed to hold the handle in position and keep the working parts together. By means of this screw the springs can be pressed more or less closely together as required. Leather rings are riveted to the inner faces of the springs, and form the surfaces upon which the knives are cleaned and polished; the rivets are in the dished portion of the springs and so out of the way of the knife-blade; the polishing powder is supplied through a hole in the face of the front spring. The knife whilst being cleaned is supported below a wrought-iron piece cast into the standard and passed in and out of the machine. The difficulty in cleaning a knife is due to its double wedge form. A knife is a long wedge from the tip to the shoulder, and a short wedge from the edge to the back, and it is evident that the pressure brought to bear upon it must be of an elastic character, so as not to grind the knife away. As regards the length of the knife this is effected by the outward taper of the rays of the springs. The two leather rings between which the blade is passed in and out being pressed against the blade of the knife by the rays of the springs as described, it is evident that there is an elastic pressure upon it; the spring on the one side diminishes in its bearing pressure, as that on the other side increases, and hence an equable pressure is applied to all parts of the blade, as is proved by the excellent polish produced. A small portion of powder being supplied through the hole in the front spring, the knife is placed with its edge downwards below the wrought-iron support and passed slowly in and out of the machine between the leather disks with the left hand, whilst the right hand is employed in turning the handle of the machine in the directio[illegible] of a clock. In this way from one inch to two in[illegible] the surface of each leather (depending upon [illegible] the machine) presses elastically upon the blade. [illegible]reatest frictional resistance at any moment be[illegible] [a]nd the polishing surfaces, the labour of cleaning [illegible] a minimum, while the knife can be polished to the sh[illegible] to the leathers being bevelled. Special tools have been designed for cutting and bending the wrought-iron supports in one operation, for cutting and bevelling the leathers, and riveting and fitting them to the springs. These machines are supplied in four sizes.

IN contrast to the weather in Southern Norway [illegible] and June (NATURE, vol. xxxii. p. 354) the weather of J[illegible] warmer and more normal, the mean temperature of the m[illegible] viz. 17·1° C. being 0·5° above the normal, 16·6°. This [illegible] due to the southern winds prevailing in the first par[t of the] month. On July 21, however, the weather changed, [illegible] and north-western winds prevailing, with clear and dry [illegible] in consequence of the great radiation, the temperature fell [illegible] times very low during the second part of the month. [illegible] minimum temperature—viz. 6·4° C.—was registered at Chr[illegible] on the night of the 22nd., and the highest—viz. 29° C.—[illegible] 6th. The rainfall was 40 per cent. below the norm[al] [illegible] the exception of the coast towards the Naze, the m[illegible] been cold throughout the land on the whole, the most [illegible] able parts being the west coast, where the temperature [illegible] below the normal mean. In the mountains and in Fi[n]marken it sank several times below 0°. The rainfall [illegible] southern and eastern parts was below the average, b[ut] [illegible] northern and north-western parts it was above it. Th[illegible] rainfall was registered in Finmarken, where, in [illegible] instance, it was 142 per cent. above the average.

THE additions to the Zoological Society's Gardens during [the] past week include a Macaque Monkey (*Macacus cynom*[*olgus*]) from India, presented by Mrs. Paterson; a Humboldt's La[gothrix] (*Lagothrix humboldti*) from the Upper Amazons, prese[nted by] Mr. F. J. Hammond; two Macaque Monkeys (*Maca*[*cus cyno*]*molgus*) from India, presented respectively by Mr. F. Del[illegible] and Miss Lucy McArthur; two West Indian Agoutis (*D*[illegible] *cristata*), seven Crab-eating Opossums (*Didelphys canc*[illegible]), two Rough Terrapins (*Clemmys punctularia*), two Br[illegible] Tortoises (*Testudo tabulata*), two Teguexin Lizards [illegible] *teguexin*), two Tuberculated Iguanas (*Iguana tubercula*[*ta*]) [illegible] Giant Toads (*Bufo aqua*) from Trinidad, presented by M[r.] [illegible] Guy; two Palm Squirrels (*Sciurus palmarum*) from India, [pre]sented by Mr. A. Bellamy; a Great Kangaroo (*Macro*[*pus*] *giganteus* ♂), a Rufous Rat Kangaroo (*Hypsiprymnus r*[illegible]) from New South Wales, a Roan Kangaroo (*Macropus* [*ru*]*bescens* ♀) from South Australia, presented by Mr. C. Clarke [illegible] F.Z.S.; a Common Crossbill (*Loxia curvirostra*), British, [pre]sented by Mr. H. S. Eyre; a Green Lizard (*Lacerta* [illegible]) from Jersey, presented by Mr. G. V. Colliver; a Guinea Baboon (*Cynocephalus sphinx*) from West Africa, two Bonnet Monkeys (*Macacus sinicus*) from India, two Ælian's Wart Hogs (*Pha*[*co*]*chærus africanus* ♂ ♂) from Africa, deposited; a Garnett's Galago (*Galago garnetti*) from East Africa, a Harnessed An[te]lope (*Tragelaphus scriptus* ♀), an Elate Hornbill (*Cerato*[illegible] *elata*) from West Africa, a Puff Adder (*Vipera arietans*) [from] South Africa, a Lacertine Snake (*Cœlopeltis lacertina*), European; an Aldrovandi's Lizard (*Plestiodon auratus*) from North Africa, purchased; a Leopard (*Felis pard*[*us*]) [illegible] Garde[ns].

## [illegible] PHENOMENA [illegible] [illegible] OCTOBER 4–[illegible]

(Fo[r] [illegible] civil day, [illegible] Green[wich] [illegible] hours [illegible] employed[illegible]

[illegible] 6h. 8m. [illegible]

Moon (New on October 8) rises, 1h. 10m.; souths, 8h. 31m.; sets, 15h. 41m.; decl. on meridian, 12° 2′ N.

| Planet | | Rises h. m. | | Souths h. m. | | Sets h. m. | | Decl. on meridian ° ′ |
|---|---|---|---|---|---|---|---|---|
| Mercury | ... | 5 10 | ... | 11 18 | .. | 17 26 | ... | 0 43 N. |
| Venus | ... | 9 55 | ... | 14 17 | ... | 18 39 | ... | 19 4 S. |
| Mars | ... | 0 15 | ... | 8 0 | ... | 15 45 | ... | 18 47 N. |
| Jupiter | ... | 4 13 | ... | 10 38 | ... | 17 3 | ... | 4 12 N. |
| Saturn | ... | 21 35* | ... | 5 43 | ... | 13 51 | ... | 22 18 N. |

* Indicates that the rising is that of the preceding day.

| Oct. | | h. | | |
|---|---|---|---|---|
| 6 | ... | 17 | ... | Jupiter in conjunction with and 1° 25′ north of the Moon. |
| 7 | ... | 20 | ... | Mercury in conjunction with and 0° 29′ north of the Moon. |

## *HEREDITY*

AT the February meeting of the Swedish Anthropological Society Prof. Wittrock read a paper on the hereditability of colour of the eyes. The speaker had been requested by Prof. Alphonse De Candolle, of Geneva, to make observations on this point, which, together with those made in Switzerland, North Germany, and Belgium, had formed the material for M. De Candolle's paper, "Hérédité de la couleur des yeux dans l'espèce humaine" (*Archives des Sciences Physiques et Naturelles*, 3e période, t. xii., Genève, 1884). From the same the remarkable fact was derived that brown eyes were more common in men than women; of the individuals examined 41·6 per cent. of men and 44·2 per cent. of women had brown eyes. Further, in families where the parents had the same colour of eyes 80 per cent. of the children of parents with brown eyes had brown eyes, whilst of children of parents with blue eyes 93·6 per cent. of them had eyes of that colour. The unconformity was no doubt due to atavisme or the hereditary influence of ancestors. Of the children of parents of whom the father had brown and the mother blue eyes 53·3 per cent. had brown, whilst where the reverse was the case 55·9 per cent. had blue eyes. As the percentage of brown-eyed children of parents with bi-coloured eyes was highest, it seemed as if brown eyes were always on the increase to the detriment of blue ones. It appeared also from these researches that women with brown eyes have better prospects of marrying than those with blue. 52 per cent. of the married women had brown eyes, and only 48 per cent. of them blue—a circumstance which is the more remarkable as the number of women with brown eyes in Italian Switzerland is only 44 per cent. Another remarkable discovery was that the average number of children of parents with eyes similar in colour was 2·7, whilst that of those with different colour was 3·18, which was an additional proof of the fact that children of parents with similar organisation were as a rule of weak constitution. Comparing the colour of the eyes of the children where the parents were bi-coloured, with those of each of the latter, it was discovered that the eyes of the father were inherited by 48·8 per cent. of the children, and those of the mother by 51·2 per cent., which, divided between sons and daughters, showed that 47 per cent. of the former and 49·5 per cent. of the latter inherited the eyes of the father, whereas 53 per cent. of the sons and 50·5 per cent. of the daughters inherited those of the mother. Since Prof. Candolle had published his paper, he (the speaker) had continued his researches in Sweden, and from the material he had collected he had discovered results differing from Prof. Candolle's. Of the individuals reported to him 29·6 per cent. of the men and 30·7 per cent. of the women had brown eyes, so that even in that country the latter were more numerous than the former, but this was no doubt due to the circumstance that [illegible] been most anxious to obtain particulars from bi-coloured [illegible] In accordance with Candolle's results, 73·6 per cent. [illegible] parents both with brown eyes inherited this colour, [illegible] with blue eyes 97 per cent. inherited that colour. [illegible] that this should be the case in Sweden, where [illegible] nated. As regards the bi-coloured parents the [illegible] Sweden too. If the father had brown and [illegible] per cent. of the children had brown eyes, [illegible] was the case 53 per cent. of them had [illegible] were the reverse of Candolle's. [illegible] 56 per cent. of the children had [illegible] the latter are on the increase. [illegible] of the eyes played in the selection of a wife in Sweden, as he had no statistics of the distribution of brown eyes in general, but there was a tendency similar to that stated above, as, of the parents embraced by these researches, the majority of wives had brown eyes. With reference to the number of children in Sweden of con-coloured and bi-coloured parents, that of the former was 4·49 and that of the latter 4·03, whilst 52·6 per cent. of the children inherited the eyes of the father and 47·4 per cent. those of the mother; of the sons 51·8 per cent. inherited the eyes of the father, and 48·2 per cent. those of the mother, which figures as regards the daughters were respectively 53·5 and 46·5 per cent. This shows that in Sweden the eyes are not predominantly inherited from the mother alone, and that the offspring of equally-constituted parents should not be weaker. The speaker stated in conclusion that he is continuing his researches. He excludes children under ten years of age from the same, and classifies blue-grey or grey eyes as blue.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE*

PROF. W. GRYLLS ADAMS, F.R.S., will deliver a Course of Lectures at King's College, London, on Heat and Light, during the Academical Year 1885-6. A Course of Practical Work in Electrical Testing and Measurement, with especial reference to Electrical Engineering, will be carried on under his direction in the Wheatstone Laboratory. There will also be a Course of Lectures on Mechanics and the Principles of Energy. The Wheatstone Laboratory is open daily from 1 to 4, except on Saturdays. For further particulars apply to Prof. Adams, King's College, London.

THE following appointments have recently been made at the Victoria University, Owens College, Manchester:—To the Professorship of Mathematics: Mr. Horace Lamb, M.A., F.R.S., late Fellow of Trinity College, Cambridge, and Professor of Mathematics in the University of Adelaide. To the Professorship of Anatomy: Mr. Alfred H. Young, M.B., F.R.C.S.

## *SOCIETIES AND ACADEMIES*

### PARIS

**Academy of Sciences**, September 21.—M. Bouley, President, in the chair.—On the development of cholera in India, by M. Gustave Le Bon. In support of Prof. Peter's view that European differs from Asiatic cholera only in the greater intensity of the causes producing it, the author argues that both forms might break out spontaneously in any country through the volatile germs arising from putrified organic matter. In his former researches he showed that, apart from these germs, there exists a series of volatile alkaloids which, when introduced by respiration, produce almost fulminating effects. These researches throw much light on the accidents attending the exhumation of bodies long buried and on the spread of typhoid or analogous fevers. The facts recently observed by M. Le Bon during a sudden outbreak of cholera at Kombakonum, in the south of India, tend to confirm this hypothesis. In India itself cholera rages almost exclusively amongst the native populations; the English, who reside in large cantonments, where sanitary arrangements are scrupulously attended to, being seldom attacked. That cholera and intermittent fevers are propagated chiefly by bad water is a point on which opinion is unanimous in that country, and the author's personal experience places it beyond all reasonable doubt.—Elements of Brooks's comet, by M. R. Radau. These elements, according to observations made at Cambridge and Paris, are found to be:—

$T$ = 1885, August 10·30457; mean Paris time.

$$\left.\begin{aligned} \pi - \Omega &= 43^{\circ}\ 0'\ 47'' \\ \Omega &= 204\ \ 33\ \ 7 \\ i &= 59\ \ 22\ \ 30 \end{aligned}\right\} \text{Mean equinox of 1885·0.}$$

$$\log q = 9{\cdot}87694$$

—Note on a new stellar spectroscope, by M. Ch. V. Zenger. This instrument is constructed on a new principle, and chiefly intended to measure simultaneously and accurately the angle of position and the distance of double stars situated very close together.—On the process of fertilisation in the Cephalopods, by M. L. Vialleton.—On the anatomical organisation of the urns in *Cephalotus follicularis*, by MM. Jules Chareyre and Edouard Heckel.

BERLIN

**Physiological Society**, July 31.—Prof. Fritsch spoke on the functions of the sebaceous glands, raising a protest against the conception, represented quite recently by Herr Unna, that these glands served only to lubricate the hairs, while the globiform glands, commonly called the sudoriparous glands, lubricated the skin and induced the formation of the subcutaneous fat, and that, finally, the perspiration was discharged by the sweat-pores, or, rather, the extreme ends of the straight canals into which the sweat found its way out from intercellular spaces through the stomata. A whole series of anatomical, histological, and physiological grounds were brought forward against this view both by the speaker and, in the course of the discussion on the subject, by Prof. Du Bois-Reymond, Prof. Waldeyer, Dr. Gad, and Dr. Lassar. All known observations and experiments were, on the contrary, they maintained, in favour of the view that the sebaceous glands provided fat for the skin, while the globiform glands had the production of sweat assigned to them.—Dr. Weyl reported on the results of a chemical examination of the cholesterin, the composition of which had not hitherto been ascertained, although this substance had been discovered more than a hundred years ago, and had since been traced in the most varied organs of the animal body and even in plants. The most searching investigation down to the present of cholesterin had been made by Herr Zwenger, who, by treatment with sulphuric acid and nitric acid, had found combinations which he had distinguished and chemically characterised as cholesterylene and cholesterone. By repeating these experiments Dr. Weyl had achieved much purer derivatives of the cholesterin, in particular chloric and bromic combinations, in very pure crystals, which rendered exact elementary analysis possible. This led to the result that the derivatives of cholesterin were found to be hydrocarburets belonging to the great class of the terpenes—that is, they were products of condensation or polymerisations of the simple terpene ($C_5H_8$). Even though it were not yet possible to state precisely the number of the $C_5H_8$ which had become polymerised in the several cholesterin derivatives, the speaker yet thought he had sufficient ground for assuming that the composition $(C_5H_8)^5H_2O$ was the one proper to the cholesterin itself. Substances which, both by their reactions and their percentage compositions, were denotable as terpenes, might also be obtained from the choleic acid, a circumstance which pointed to the more intimate relation between cholesterin and choleic acid.—Dr. Biondi communicated the results of an investigation carried out by him in the Institute of Prof. Waldeyer with a view to throwing light on the origin of the spermatozoids in the seminiferous canals—a question on which the views of physiologists were so widely divergent. By appropriate use of appliances for hardening, fixing, and colouring, among which the advantages of Flemming's fluid had to be mentioned with quite special prominence, Dr. Biondi arrived at results which corroborated none of the views formerly put forth, but which explained the earlier observed facts. In accordance with these results it had been endeavoured diagrammatically to distribute the contents of the seminiferous canals into columns, which, proceeding from the wall towards the central cavity, might be grouped into three layers. In the first stage of development, a stage always met with, in particular, in animals not yet ripe, the extreme layer lying on the wall of the canal consisted of round, primitive cells, the second layer, proceeding inwards, of round mother-cells, which were very rich in caryokinetic figures, and the third innermost layer consisted of a larger number of small round daughter cells. In a second stage of development observable in ripe glands the nucleus of the daughter cells were seen converted into spermatozoids, the exterior half of the nucleus becoming the head and the other interior half [illegible]iddle part and tail of the spermatozoon. The prot[illegible] daughter cells took no part in this transformation[illegible] the bodies of the spermatozoa, making them co[illegible] from which the tails of the spermatozoa project[illegible] central canal. These masses of protoplasm [illegible] bodies of the spermatozoa altogether resemble[illegible] described by the earlier observers as "Spermatob[illegible] this stage the above diagrammatically assumed column [illegible] from the outside inwards, of the primitive cell, the cell, and the bundle of spermatozoa. In the next stage of [illegible]lopment the formation of the spermatozoa, arising always [illegible] same manner from the nucleus of the daughter cells, was [illegible] farther outwards, so that the column now consisted of [illegible] large round cell on the outside and bundles of sperma[illegible] the inside. The formation of the seminal corpuscles advan[illegible] further, and at last the whole column, as far as the wall of the [illegible] consisted of spermatozoa, the bodies of which were agg[illegible] into bundles by masses of protoplasm, their tails being dire[illegible] wards. Primitive cells out of neighbouring columns n[illegible] calated themselves between the wall of the canal [illegible] spermatozoa, pushing the latter towards the middle. [illegible] development of the mother and daughter cells the sperm[illegible] were quite pressed and discharged into the central ca[illegible] process thus described then began anew. It must, ho[illegible] observed that in nature there was no separation into [illegible] and layers such as was here diagrammatically descr[illegible] was only for the sake of clear representation that the [illegible] succeeding each other in time were thus exhibited as [illegible] space. Dr. Biondi had examined this structure of the [illegible]iferous canals, and this development of the spermat[illegible] the bull, the swine, the cat, the rabbit, the [illegible] the rat, and other mammalia; and in all these [illegible] had found alike the same results. Prof. Waldeyer [illegible] that Dr. Biondi had attained to these results quite inde[illegible] and had communicated and demonstrated them to [illegible] early as February of this year. It was only on his a[illegible] Dr. Biondi had further examined a longer series of [illegible] before publishing his results. A few days ago, continue[illegible] Waldeyer, he had received a letter from Prof. Gr[illegible] Königsberg, in accordance with which he (Prof. Gr[illegible] had attained to the same results on spermatogenesis as [illegible] Biondi, to whom, of the two independent discoverers, [illegible] the title of priority.—Dr. Blaschko briefly explained [illegible] microscopic preparations he exhibited, which served [illegible] that between the epidermis and the cutis there lay no ce[illegible] substance; but just as it was long known that in the [illegible] the epidermis cells they had processes growing [illegible] digitately into one another, so here, too, the processe[illegible] epidermis and cutis cells were seen to intertwine with [illegible] other and form a network, the meshes of which were par[illegible] large in an œdematous skin.—Dr. Lassar demonstrated [illegible] scopic preparations of skin which he had excided from a [illegible] suffering under lichen ruber. In the copious protopla[illegible] exudation of the inflammation) surrounding the canals [illegible] epidermis there were seen, after colouring with fuchsin [illegible] Bismarck-brown, an uncommonly large number of mic[illegible] distinguishing themselves particularly by their remarkab[illegible]ness.

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

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THURSDAY, OCTOBER 8, 1885

## MR. GRIEVE ON THE GAREFOWL

*The Great Auk, or Garefowl (Alca impennis, Linn.), its History, Archæology, and Remains.* By Symington Grieve, Edinburgh. 4to, pp. x. 141, and Appendix, pp. 58. (London: Jack, 1885.)

AGREEABLY to the wish of the editor of NATURE that I should notice in its pages the lately-published volume whose title stands above, I undertake a responsibility of a kind which is for me as delicate as can be imposed upon anybody. It has long been no secret that for more than five-and-twenty years—since, indeed, the premature death, in 1859, of my friend and fellow-traveller, the late Mr. JOHN WOLLEY—I have had it in hand to prepare and eventually to produce a monograph of the presumably extinct species of bird, into the investigation of whose history he had thrown himself with all the energy of his character. During that time I am not conscious of having ever lost an opportunity of adding to my store of information on the subject, in doing which I was for several years assisted by the zeal of the late Mr. G. D. Rowley; and, though always having in view the ultimate publication of the monograph originally contemplated by Mr. Wolley, I never hesitated to supply any inquirer with the particulars for which he asked—as may be seen on reference to the publications of Dr. Victor Fatio[1] and of Prof. Wilhelm Blasius[2]—both of whom I rejoice to think I was able in some measure to help. Nevertheless, each attempt to elucidate the natural history of the Garefowl only added to the number of still unanswered or unanswerable questions relating to it; and, amid numerous other occupations or duties, I have with difficulty been able to keep myself abreast of the ever-increasing contributions to the subject—many (I may say most) of them proving on investigation to have little or no foundation; and those which had the least, or none at all, generally giving the greatest trouble.

Apology, I feel sure, is needed for an introduction so egotistical as that contained in the foregoing paragraph; yet without it, or something like it, I fear my remarks on the book before me may be misunderstood. The force of circumstances has compelled me to set up a very high standard; and, when that standard has not been approached by any writer on the subject, it is almost impossible for me not to see his shortcomings, though many another man might find in him no fault at all. I therefore wish at once to record my opinion that in the present work the author has done the best that in him lies, and especially that his book, so far as it goes, is an honest book. If, after working at the subject for more than a quarter of a century, a man still finds himself unable, from one cause or another, to publish the results of his labour, it does not follow that he should be hard upon anybody else who, with perhaps as many distractions, makes a praiseworthy attempt to set before the world what is known of the lost species, though he may not have devoted to the task a tenth of the time. Moreover, Mr. Grieve begins his preface with the words: "In submitting these pages to the public, the author has fears that they will not bear severe criticism." I regret to say that regard to truth obliges me to declare that this is so; but I have no wish to be the severe critic, and it will be best here to describe the plan and scope of the work, which is obviously well chosen. Mr. Grieve begins with a very appropriate dedication to Prof. Steenstrup, that venerable biologist who first wrote a history[1]—he modestly called it only a "contribution" to a history—of *Alca impennis* that was in accordance with facts, and was worthy of the subject, of science, and of himself. The amount of indebtedness to him, due from all his successors in the investigation—but not always acknowledged—is not to be overrated. Hard as they may have found their work, it has almost entirely lain in clothing the form that he constructed; and, though there has been plenty of false tailoring, his outlines have proved to be true in almost every particular. In the dedication Mr. Grieve very justly states that he has not "much to relate that is new to British ornithologists;" but his desire has been "to bring within the reach of all, materials that at present are difficult of access."[2] These preliminaries over, the geographical range of the species—first in American and then in European waters—is entered upon, care being taken to warn the reader against the popular misconception that it was ever a bird of the high north, and then is given a description of its remains as found in the New World and in the Old. Under the last category come four chapters treating respectively of the discovery of its bones in Caithness, and in Oronsay, of the period to which the kitchen-midden on that island containing them presumably belongs, and of the single fragment found near Whitburn-Lizards, on the coast of Durham, by Mr. Hancock, which fragment, being the greater portion of the maxilla of what seems to have been an exceptionally large example, now in the Museum at Newcastle-on-Tyne, is very delicately figured (p. 64). After this Mr. Grieve enters upon a consideration of the bird's habits and of the regions in which it lived, and then proceeds to catalogue at some length (pp. 76-114) its existing remains—whether bones, skins, or egg-shells. Then follow three chapters on the uses to which the bird was put by man, on the names by which it has been known, with their possible origin and meaning, and on the period during which it lived. No fewer than nine appendices are added—all more or less of the nature of *pièces justificatives*—while an excellent index, with remarks on the accompanying chart, completes the volume, which is illustrated by several woodcuts and a couple of coloured plates representing the two eggs that doubtless came to Edinburgh in 1819 with Dufresne's collection, when it was bought by the University there, and, having been transferred to the Museum of Science and Art in the northern capital, were first publicly noticed by Major Feilden in 1869.

There cannot be a dispute as to the great pains which the author has taken with this work, but it would be inexpedient here to attempt any criticisms of its details, to an abundance of which exception may be taken. The

[1] *Bull. Soc. Orn. de la Suisse*, ii. pt. 1, pp. 5-70, 73-85.
[2] *Ver. f. Naturw. zu Braunschweig*, iii. pp. 89-115; *Journ. für Orn.*, 1884, pp. 58-176.

[1] *Vidensk. Meddel. Naturh. Forening i Kjöbenhavn*, 1855, pp. 33 to 118.
[2] Here may be added that, if report speaks truly, so strong has been this desire on the part of the author, that the book is sold to the public at less than cost price.

fact seems to be that up to a certain point the story of the Great Auk can be worked up and told by any one willing to labour at it. Beyond that point the difficulties begin. Mr. Grieve appears to be hardly aware of the existence of these difficulties, though some of them have been hinted at, if not pointed out, by his predecessors. The most serious charge that can be brought against him is that he has needlessly raised fresh difficulties for future investigators. Mistakes that have taken years of labour to correct, and the correction of which has been published, are again set agoing, just as if no progress in that direction had been made; and, even worse than this, some new assertions, or at least suggestions, are hazarded that have, I am persuaded, no firm ground. No doubt on some of these points I may be prejudiced; but according to my knowledge I perceive that on too many questions Mr. Grieve has been unable to distinguish between good evidence and bad. However, there is in this book a distinct gain to all historians of the Garefowl, and that is the information here first placed on record by Mr. Champley of Scarborough, who is known to have interested himself for many years in all that concerns this species.

I most sincerely wish that I could accord higher praise to this work than I have been able to do, for Mr. Grieve's enthusiasm in the cause deserves greater success. It is seldom that any one but a Fennimore Cooper or a Charles Kingsley feels the romance that clings around the history of an expiring race. Most men—men of science especially—nowadays believe in the survival of the fittest, and are content to let the dead bury their dead. The moral lesson I do not venture to draw, and in conclusion have only to ask pardon of the readers of NATURE for putting myself so forward in this article.

ALFRED NEWTON

## *"THE WAVE OF TRANSLATION"*

*The Wave of Translation in the Oceans of Water, Air, and Ether.* By John Scott Russell, M.A., F.R.S. (London: Trübner and Co., 1885.)

THE late Mr. J. Scott Russell was one of the most prominent and gifted naval architects which this country possessed in the middle of the present century. His name will long be remembered as the builder of the *Great Eastern*, the early advocate of the longitudinal system of framing iron and steel ships: the ingenious and eloquent expounder of the "wave line" principle of design; and for many improvements in the theory and practice of iron steamship construction. His personality was at once striking and attractive, and his abilities were of an original and versatile kind. He was the author of a massive work upon naval architecture; and of numerous papers read before various learned societies. No one exercised greater influence than Mr. Scott Russell in promoting the cause of scientific education in naval architecture, and in stimulating and helping students, by numerous speeches and writings, to acquire a general and clear knowledge of the laws upon which the qualities of ships depend.

Mr. Scott Russell's writings were always interesting. He possessed the rare faculty of making the driest and most complicated of subjects intelligible, and even fascinating. Where he may not be correct in the hypo-theses, or justified in the sweeping generalisations he sometimes hastily put forward, he is usually suggestive and provocative of thought upon the part of his reader. He was a vigorous and clear—though with a tendency to be a too rapid—thinker; and there are no writings on naval architecture which have the power of fixing attention and stimulating the intellect in a greater measure than those of Mr. Scott Russell.

We regret to say that the present work is not likely to ... to the reputation of its author. It exhibits *les défauts de ses qualités* in their most pronounced form; and if we ... asked for an example of Mr. Scott Russell at his ... weakest and worst we could hardly do better than ... that portion of this book which has not been before pub-lished. One-half of the volume is devoted to a re... the Report made by Mr. Scott Russell to the British ... ciation in 1842-43, in which a description is given ... "solitary wave of translation," which he discovered himself in 1834, and the properties of which he did ... to investigate and make known. This Report is ... printed *in extenso*, but Part I. of the work consists ... sively of extracts from it. The same matter appears ... over—once as Part I. of the book, and once as ... the British Association Report. The Report ... the knowledge possessed by Mr. Scott Russell ... "the varieties, phenomena, and laws of waves, ... conditions which affect their genesis and propa... This may be interesting from a biographical ... view, but its present scientific value is not great ... things have happened since the date of this Re... such as the theoretical investigations of Airy, ... Rankine, Froude, eminent French mathematicians ... others; and numerous observations have been ... the forms and properties of waves by scientific ... our own and foreign navies. These constitute ... of information which the present work ... ignores.

One half of the book is taken up with the reprint ... British Association Report referred to, and with the ... tracts from it of which Part I. is made up. The rema... half contains the only new matter now published ... is divided into two sections, one being "on the ... between the solitary wave in water and the sound ... air," and the other "on the great ocean of ether ... relation to matter." The less said of these chapters ... better. The following is an instance of how Mr. ... Russell frames a theory or invents a hypothesis. "I ... impressed with the truth of this law, that the velo... this solitary wave in any fluid is due to the depth ... fluid in which it moves, whether thick or rarefied ... hazard the hypothesis, that in the unknown element ... pervades the universe, and which, though unknown ... cause and medium of the most familiar phenomena ... everyday life, proceeding on the same basis of calcul... as in the air and water occurs. ... find that ... ethereal ocean should be give... miles, and that the correspon... wave the ... ocean wou... secor...

A ... med ...

"Th... ce in t...

with ... ording ...

*nearness*, and I propose to take as the law of repulsive force, the *cube of the nearness.* I think I am justified in taking this as the true law of repulsion of atoms of matter, because I find from the researches of eminent chemists that all free gases do so expand as to double their bulk by an increase of the distance of the particles, in the ratio of the cube of their nearness, or as 111 cube to 367." Then the theory of heat that is put forward appears to be a kind of material theory: "We may therefore define heat as *the effort of ether to resist crowding. . . .* Ether existing all around us in a normal state may be called *free ether.* Ether enclosed by force in limited space surrounded by material atoms is imprisoned or stored ether; its greater or less degree of crowding or storing means degrees of heat, and the quantity of crowding among the atoms indicates the specific heat of these atoms, and sometimes the specific heat of that kind of matter."

One more extract and we have done:—"Even Sir Isaac Newton's calculations of the speed of sound fell 100 feet short of the truth, and therefore corresponded to an error of a mile in the height of the atmosphere, and he could invent nothing better to account for the error than this sudden inflammation of the atmosphere. To this the reply is that the existence of the solitary wave of translation was not known to Newton, that the nature of its genesis and propagation could not therefore be calculated; but that present knowledge of the nature and laws of this wave completely explain and accurately measure its phenomena without the introduction of any hypothesis contradicted by fact."

We have said enough to show the character of this treatise, and we will conclude by repeating that we are sorry to see a posthumous work by so eminent a man as the late Mr. Scott Russell, containing nothing more to justify its publication than a reprint of his well-known, and imperfect, views in 1843, upon wave motion, and a fanciful interpretation of great physical laws. It is a pity that greater skill and discretion were not brought to bear upon the production of this volume.

## *OUR BOOK SHELF*

*Publication of the Norwegian Commission of the Measurement of Degrees in Europe.* (1) Geodetical Operations, Part IV. (2) Tidal Observations, Part III.

THE first of these publications contains an account of the northern portion of the trigonometrical work undertaken to connect the side Stokvola-Haarskallen with the side Spaatind-Næverfjeld. The former side is directly connected to the base measured in 1864 near Levanger, as described in Parts I. and III. of the "Geodetical Operations."

A trigonometrical survey of this part of the country had already been made in 1835-6 by Gen. Broch, and it was at first hoped that this survey could be utilised, but on closer investigation it was found that the observations were not of sufficient precision to meet the requirements of the Commission for the Measurement of degrees in Europe, for which th[illegible]rk was to a great extent undertaken. The old [illegible]re, however, utilised in the [illegible] part of [illegible]; there the signals were [illegible] maso[illegible] the southern portion, [illegible] cases entirely dis- [illegible] A careful descrip- [illegible]v case, with one [illegible] placed at the centre of the station; the usual measurements for reduction were therefore made, and apparently with more than usual care. The observations were taken with a 10-inch universal instrument made by Olsen and with a 12-inch theodolite made by Reichenbach. It would appear that the graduation of these instruments is not of a very high order; at any rate, the differences in the readings are rather large, frequently exceeding 10″; but in extenuation it must be said that the instruments were too small for the work and that the observations were made under considerable difficulties, owing to sea-fog and snow. There is nothing special to remark in the method adopted to adjust the observations, it being the usual method founded on the principle of least squares. It is shown that the mean error of the finally-adjusted angles is

$$0''\cdot547 \pm 0''\cdot029.$$

A diagram of the triangulation is given, from which it is seen that most of the triangles are well-conditioned; a few, however, are more elongated than they should be for good work, the triangle Munken, Stokvola, Haarskallen, especially so; for instance, the angle at Munken is 5° 12′ 57″·416. It should also be observed that several of the stations are determined by only two intersections. The longest side measures about sixty miles.

The second publication is the third report of the Norwegian tidal observations, and contains the results of the work done at Oscarsborg in 1880-1 and at Stavanger, Bergen, Kabelvaag, and Vardö in 1883. This report is simply a continuation of Reports I. and II., already noticed in NATURE; it contains nothing but tables, and there is nothing in it that calls for special notice.

## *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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### On the Influence of Wave-Currents on the Fauna of Shallow Seas

FOR many years past I have endeavoured, without much success, to call attention to the widely-spread influence of waves on the bottoms of shallow seas. To the geologist this action signifies denudation, and accounts, among other things, for the wholesale destruction of marine fauna so often exemplified in the rocks. To the zoologist it signifies a factor in evolution of immeasurable magnitude.

On seeing the abstract of Prof. Moseley's lecture on the fauna of the sea-shore in NATURE, I troubled you with my letter of July 6; now that the full report has appeared, equally reticent as to the significance of wave-currents, I ask leave to add somewhat to my former letter.

The difficulty in arousing interest in this subject arises from the fact that, though the phenomena of wave-disturbance are well known to mathematicians, natural history text-books commonly agree in asserting either the non-existence, or unimportance, of such disturbance. Thus the question has remained unheeded.

My own experience in the matter is as follows:—Holding the orthodox view of the peaceful repose existing on the sea-bottom, I commenced cruising, some twenty years ago, on that excellent natural experimental tank, Torbay. I soon found, to my surprise, that the local fishermen and dredgers were as confident that the waves greatly disturbed the bottom as naturalists were of the reverse. Having kept my eyes open in this direction, I submitted a paper to the Devonshire Association in 1878, descriptive of the levelling action of the waves on the six-fathom area of Torbay (*Trans. Dev. Assoc.*, vol. x. p. 182).

With the kind assistance of Lord Rayleigh I was enabled to show that theory and observation were in complete accord: a to the energy evinced by the waves in the particular instance under consideration.

Having learned from Lord Rayleigh that wave-action at the sea-bottom takes the form of reciprocal currents, I was led to make some experiments and observations on the formation of ripple-mark. In the course of this investigation I was soon impressed with the conviction that these alternate currents held at their mercy the marine fauna exposed to their attacks, and that the zoological side of the problem was at least as important as the geological. Accordingly, an outline of the subject in its zoological aspect was included in a paper on ripple-mark read to the Royal Society in 1882 (*Proc.* R.S., vol. xxxiv. p. 1).

Having come into possession of confirmatory evidence of the action of waves at a depth of forty fathoms in the English Channel, I submitted the facts to the British Association at Southampton in the same year, 1882. This paper, sent in to Section A, was handed on to Section C, a mathematical friend suggesting to me the reason, and a very good reason too, that mathematicians required no evidence on the point contended for. However, the transfer only went to prove that the geologists were as sceptical as to the existence of wave-action at forty fathoms, as the physicists were satisfied as to that fact. This paper, amplified, appeared in the *Transactions* of the Devonshire Association for 1883 (vol. xv. p. 353).

The zoological aspect of the question was submitted to the British Association at Southport in 1883; and again to the Linnean Society in 1884, in a paper "On the influence of wave-currents on the fauna inhabiting shallow seas." In this paper, profiting by experience, I made no attempt to prove the fact of wave-action from observation, but relied entirely on a valuable letter with which I had been favoured by Prof. Stokes, Sec. R.S. Neither at the British Association nor at the Linnean Society was any exception taken to my arguments in support of the importance of wave-action on the fauna affected; nor, so far as I am aware, has my position been shaken since. Now that Prof. Moseley's important lecture has appeared, discussing the fauna of the sea-shore without reference to the ever-regulating wave-currents, there is considerable risk that less experienced students of natural history will in like manner pass over this promising field of research as not worthy of their attention.

Prof. Moseley states, and states truly, that the littoral fauna is adapted in various ways to withstand "the action of the surf, the retreat of the tides, the numerous enemies"; but, beyond the reach of surf and tidal fall, agents which only affect the narrow belt of sea contiguous to the shore, the alternate currents set up by ocean waves search out the armour and test the defences of all small animals living on those extensive marine areas, exposed to the ocean swell, where the depth of water does not exceed fifty fathoms.

With respect to enemies, the waves themselves are perhaps the most formidable, as they attack and occasionally destroy whole colonies at once, whereas predatory foes rather affect the individual. For instance, let such helpless mollusks as *Aplysia* or *Pleurobranchus* wander over the sandy bottom of Torbay, as they sometimes do: the first easterly gale will sweep them out of existence. In fact, the waves so invariably prevent *Aplysia punctata* growing to its full size on the British coast, that a full-grown specimen taken in protected Guernsey waters has been considered a distinct species—viz. *A. depilans*. Similar large specimens have occurred under the shelter of the Torquay harbour works, but these, by a series of odontophores and shells, I have been able to connect with the common *A. punctata*.

*Primâ facie* it would appear that the shells of certain mollusks are more especially adapted to resist animate foes; but a close examination will often prove the contrary. Take the cases of the oyster, mussel, venus, and limpet: these mollusks are all helpless in the presence of their living enemies: the oyster perishes by the attacks of boring-sponges; the mussel is destroyed wholesale by starfishes; the venus is perforated by carnivorous gastropods at their leisure; whilst the limpet, easily detached when taken unawares, is said to be destroyed by birds. All four are, however, admirably adapted to resist wave-currents, each in its respective habitat.

The conclusion that the shells of mollusks are so constructed as to have comparatively but little reference to living foes is supported by the interesting fact mentioned by Prof. Moseley, that hard shells tend to disappear in pelagic and deep-sea regions. That is to say, they disappear where predatory enemies abound, but where the great non-predatory enemies, the waves, are powerless or not existent. Occasionally we find the supposed protection against living enemies to be greatly in exce[ss of] requirements—*e.g.* the case of the solen, whose power of bur[row]ing is far greater than requisite for escape from birds, but [it] is none too great for the evasion of waves and currents [tha]t away the sand in which the mollusk dwells.

Wave-action tends to differentiate species. This can be [seen] in such obvious cases as *Cardium aculeatum* and *C. ech[inatum]*, *Venus dione* and *V. chione*. One of each of these pair[s has] chosen the mooring method of defence with anchor-like sp[ines], the other that of facile penetration with smooth, unarm[ed] shell surfaces. As these two methods are opposite in [aim], and any compromise tends to inefficiency, the wave-cur[rents] must necessarily influence the mollusks in the direct[ion of] divergence.

Instances of habits and forms protective against wave-[action] could be multiplied almost *ad infinitum*, and, as the subje[ct is a] very interesting one, I still live in hopes that it may [be] taken up and worked out by trained observers qualified [for the] task.

ARTHUR R. H[UNT]

Torquay, September 28

## Prehistoric Burial-Grounds

THE account given in this week's NATURE (p. 518) of [the dis]covery of a prehistoric burial-ground at Pitreavie has [recalled] to my memory the description of a similar find made [in the] eleventh or twelfth century by the monks of Noyon, and [handed down] to us us by Guibert, who was abbot of this foundation [at the] time. I believe that it is the earliest detailed account [of] such discovery that has come down to our days; and it [will be] noticed that the leading features of this cemetery are exactly identical with those of the Pitreavie one. I [am not] aware that this passage has attracted the attention of writers upon prehistoric times.

Guibert, the author quoted, was born in 1053 and [died in] 1124, having been Abbot of Noyon for about twe[nty years]. After stating his own conviction that his monast[ery was] extremely old, he continues:—

"Quam opinionem, si nulla litteralis juvaret tradi[tio, ...] peteret profecto affatim peregrina, et non, putamus, C[hristiani] nominis sepulchrorum inventa contextio. Circa enim ip[sam] ipsa basilica tantam sarcophagorum copiam conjunxit a[ntiquitas] in multam loci famositatem tantopere expetiti, cadav[erum] congestorum commendat infinitas. *Quia enim non* [...] *nostrorum ordo disponitur sepulchrorum, sed circ[ulari]* *modum corollæ sepulchrum unius multa ambiunt,* [in] *quædam reperiuntur vasa, quorum causam nesciunt* [...] *tempora.* Non possumus aliud credere nisi quo[d] [...] gentium, aut antiquissima Christianorum, sed facta gen[...]

GUIBERTI Novig. *de Vita Sua*, L. i[i]

I may add that in Guibert's time there was a very [...] tradition which ascribed the foundation of Noyon t[o] [a] "rex insulæ Britanniæ," who was (so ran the leg[end] [a con]temporary of our Lord's. This tradition is, of course [...] from a historical point of view, but certainly test[ifies to the] extreme antiquity of the place; and shows that, [in] Guibert's time, the inhabitants of Noyon had dim r[ecollections] of their prehistoric greatness, which naturally, in [...] Christian credulity, centred around the era of our L[ord].

T. A.

158, Walton Street, Oxford, September 30

## *MARS, JUPITER, AND SATU[RN]*

WITH Mars, Jupiter, and Saturn in the m[orning sky] the telescopist has a varied assortment [of] objects to which he may devote his attention. [The] distance of Mars during the ensuing oppositio[n has] the effect of limiting the apparent diameter [...] value, but the chief markings are so conspicuo[us as to be] visible notwithstanding this inimical effect [...] during the preceding opposition, which was [...] favourable, some of the more delicate feature[s] have been recovered. At Milan Signor Schi[aparelli has] partly confirmed his previous results as to t[he] duplication of the "canals," and Mr. Knobel h[as] a series of valuable sketches, which are reproduced in the last volume of the *Memoirs* of the Royal Astronomical Society. With regard to Jupiter the declination of the planet will be somewhat less than during the opposition of 1884-5, but the configuration of the belts and the peculiarities of the variable spots will doubtless continue to be exhibited with nearly similar prominence as in previous years. Saturn, situated in Gemini, and having considerable N. declination, will present a grand display, the rings being still widely open and inviting that close and systematic scrutiny which is so much needed either to affirm or negative some of the questionable details suggested by recent observations.

Observers of Mars are extremely fortunate in possessing such valuable memoirs and charts as those of Schiaparelli, Terby, Green, and others, which form a comprehensive and accurate basis of future reference and comparison. The seeming permanency of the chief lineaments on Mars and their distinctness of outline have permitted observers to assign their forms and positions with great nicety. But this has been found practically impossible in respect to any of the other planets of our system. Their markings are of so variable a tendency or so uncertain and ill-defined, owing probably to their atmospheric character, that it is out of the question to frame representative views that will serve to express the appearances observable at any future time. We have accumulated a vast number of delineations, including many peculiar forms, but these exhibit so much discordance as to prove that any attempt to arrange them with the same consistency as those of Mars must for the present be utterly futile.

What is essentially required in furtherance of our knowledge of areographic features are delineations in which the more delicate alternations of light and shade are faithfully portrayed. The ensuing opposition, though not offering the most favourable inducements for attaining this end, may yet be utilised as likely to afford its share of corroborations to old features and perhaps indicate some modification of the outlines attributed them by former observers. Mr. Marth's valuable ephemerides in the *Monthly Notices* supply the data wherewith the passages of certain prominent markings across the central line may be readily calculated from night to night. Drawings effected at the telescope and subsequently attested by the charts, or independent projections made on the basis of the new drawings and then compared with previous work will be important as furnishing fresh confirmations and additions to old records. Whatever plan is adopted, observers must not regard existing delineations as *perfectly* reliable and prejudice the judgment by endeavours to discern the outlines of the spots precisely as they have already been figured. Our work should be pursued apart from such influences, the aim being rather to correct and extend past results, than to follow them with implicit faith and mould our new seeings on the same pattern. Though much has been accomplished by the consecutive labours of the many able and earnest students of Martian features, the present state of our knowledge is not only incomplete, but considerable uncertainty exists as to the more difficult formations comprised in the physical aspect of this planet.

Jupiter, with so great a diversity of atmospheric phenomena, some of them rapidly variable, and all influenced by the quick rotation of the planet, gives prospect of being the subject of increased investigation. Late in the preceding opposition the great red spot which had so nearly disappeared and had, during the winter of 1884-5, assumed the appearance of a red ellipse with interior light cloud, showed unmistakeable evidences of increasing condensation. The ellipse grew perceptibly darker, and the central light cloud disappeared, so that at the end of the opposition the spot had almost regained the striking aspect it presented a few years ago. The question now is has this well-known feature continued to gain ascendancy during the time the planet has been lost in the sun's rays? Observations in October will furnish a definite answer to this question, and the planet should be confronted with our best telescopes as early as possible, so that the necessary evidence may be obtained. The spot will pass the central meridian of Jupiter at about the following times, and ought to be well seen in small instruments unless some great changes in an unexpected direction have affected its position or appearance in the interim since the last observation made here on the evening of July 8:—

| Date 1885 | Red Spot Central h. | m. | Date 1885 | Red Spot Central h. | m. |
|---|---|---|---|---|---|
| Oct. 7 | 18 | 34 | Oct. 29 | 16 | 48 |
| 12 | 17 | 43 | 31 | 18 | 26 |
| 17 | 16 | 52 | Nov. 3 | 15 | 56 |
| 19 | 18 | 30 | 5 | 17 | 34 |
| 24 | 17 | 39 | 7 | 19 | 13 |
| 26 | 19 | 17 | 10 | 16 | 43 |

With reference to the white spots bordering the dark belts, and the other definite markings, they will doubtless be remarked as heretofore. Their singular vagaries of motion and appearance call for renewed study. The varying intensity and colour of the belts and their disposition in latitude should be carefully assigned on several dates during each opposition. If this method could be persistently followed during many years it would supply the material either for tracing out periodical recurrences, or proving such changes to be intermittent in character.

During the past opposition of Jupiter much attention was directed to the transits of the satellites and their shadows. When near mid-transit, III. and IV. are often seen as black spots, I. is visible as a grey spot, while II. is rarely, if ever, visible otherwise than as a bright spot. These anomalies have never received a satisfactory explanation, and further observations are much required as to the relative tints of the satellites when on Jupiter and the variations noticeable in different transits.

Saturn, though not presenting such an extent of conspicuous detail as Jupiter, is yet equally deserving of systematic study. The rings and numerous array of satellites compensate for lack of detail in the belts. The outer division in the ring, called after Encke, supplies us with a crucial test object, and one which perhaps has originated more difference of opinion amongst observers than any other planetary detail of which the existence is well assured. Either this division must be liable to fluctuate at short intervals or the evidence afforded by various telescopes is most conflicting, and suggests how careful we should be before accepting individual results when not corroborated or supported by undeniable testimony.

During the last few oppositions a very definite narrow dark belt has bounded the southern side of the equator, and this has attracted more comment than usual owing to its compact and very obvious appearance. This belt exhibits no distinct spots, though one or two observers have delineated it with marked condensations. The fainter belts nearer the pole are so very feeble that their existence is sometimes questionable. Indeed the features of this planet are of extreme delicacy, and require not only very steady air but a thoroughly good eye and instrument to trace them in their more minute forms. Some of them are doubtless variable and have given rise to the contradictions we have referred to. As to the satellites they comprise test objects for telescopes of all calibre. The identification of these bodies may be suitably effected at any hour by means of Mr. Marth's ephemerides (*Monthly Notices*, June, 1885).

W. F. DENNING

## RADIANT LIGHT AND HEAT[1]

### III. (Continued.)

### Absorption—Terrestrial Applications.

LET us next consider the absorption spectra of substances, that is to say, the absorption lines which substances at ordinary temperatures produce in the spectrum of light from a high temperature source, such as the sun or the electric arc. This absorption may either be general or selective; it may be spread over a large portion of the spectrum, or it may act specially over a very limited district or line. It is in the latter case that we derive most advantage by studying absorption spectra, and there are many substances which may be known at a glance by means of their peculiar absorption. Professor Stokes has shown, for instance, that blood may at once be distinguished from other solutions of similar tint by means of the characteristic dark bands which it produces. By means of a spectrum microscope Mr. Sorby thinks that the thousandth part of a grain of blood may be detected, and the same observer asserts that wines of different vintages can easily be distinguished from one another in the same way. It thus appears that the absorption spectrum may in many cases furnish us with an efficient and simple means of ascertaining adulteration, for the presence of inferior substances which escape detection by the taste or sight will [illegible] be [illegible] when spectrum analysis is employed. [illegible], Gladstone, Miller, Hartley, and others have studied with much [illegible] the spectra of solid and liquid bodies.

The absorption spectra of gases and vapours at low temperatures have been studied by various physicists, and amongst them [illegible], Roscoe, Schuster, and Lockyer. Brewster, as we have seen, was the first to observe the effect produced on the solar spectrum by nitrous acid gas; other gases have since been treated in the same way, and many of these give out channelled or fluted absorption lines similar to those given out by nitrous acid gas. In fine, various researches lead us to conclude that gases, and more [illegible] vapours, are in a state of greater molecular complexity [illegible] at a high temperature, for at a low temperature they have a prominent absorption [illegible], whereas at a high temperature they [illegible] absorption power [illegible] only a few [illegible] spectral lines.

This [illegible] temperature [illegible] Lockyer, and [illegible] the [illegible] of spectrum analysis.

Meanwhile, I [illegible] Lockyer [illegible] NATURE [illegible] [illegible]

[illegible]

additional complication is introduced [illegible] one of these causes of variability may [illegible] such a way that in those years when [illegible] sun is intrinsically most powerful [illegible] normally large amount of aqueous va[illegible] solved in the air, so that we may have [illegible] an increased absorption as well as [illegible] tion, and the one of these causes may [illegible] extent, cover or conceal the other.

Bearing these points in mind, I shall [illegible] into two sections. I shall treat, in the [illegible] means which we have at our disposal for [illegible] whole amount of radiant energy which [illegible] the sun at any station, whether this be [illegible] sea or at an elevation above it.

*In the second place*, I shall allude to [illegible] have at our disposal for estimating the [illegible] one kind of radiant energy that reaches us [illegible]

An instrument by means of which we [illegible] the amount of the sun's radiant energy [illegible] *Actinometer*.

I have recently suggested such an [illegible] measuring the heating effect of the sun, wh[illegible] tried at various stations, and appears to [illegible] consists of a thick hollow cube of brass, [illegible] felt, and then again with a covering of [illegible] Into the interior of this chamber a suitable [illegible] is inserted, its bulb being exactly in the centre [illegible] a small hole in one of the sides, through wh[illegible] of the sun condensed by a lens is made to [illegible] bulb of the thermometer, the instrument having [illegible] in altitude and azimuth so as to enable it to [illegible] sun readily. The exposure is made for a defin[illegible] given by a good chronometer.

Instruments of this kind have been [illegible] various places and at various elevations, and [illegible] certainly be able to derive from them information [illegible] portance as regards the meteorology of the [illegible] what extent we shall be able by their means to [illegible] between the two apparent causes of solar [illegible] namely, that due to an intrinsic change in the su[illegible] and that due to a change in the constitution of the [illegible] atmosphere, is perhaps an open question. [illegible] hoped that such an instrument may at least [illegible] to advance the problem, even if it prove [illegible] bring it to a complete solution.

Again, Professor Sir Henry Roscoe has [illegible] instrument intended to record the effect of the [illegible] his [illegible] of silver. He is able to [illegible] paper of a standard sensitiveness, which, by [illegible] arrangement, is exposed for known [illegible] This is an instrument from which we [illegible] [illegible]

[illegible]

Langley of his Bolometer, which ... detecting and measuring small ... [illegible] ... the fact that the ... [illegible] ... if, however, a portion of ... be heated, its resistance will be ... current passing through ... two opposing currents ... other, and in consequence the gal... ll be deflected ... the two circuits each contains a sheet ... [illegible] ... so that a ... small

shaded curve above the spectrum represents the observations made by Professor Langley with his Bolometer at the foot of the mountain. We have next a dotted curve derived from observations at the top of the mountain, and finally another representing the probable curve ... [illegible] ... the limits of the atmosphere. It ... [illegible] ... if we could view the sun beyond the limits of the atmosphere the light would be ... [illegible]

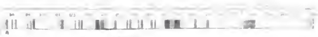
There can be no doubt that the improved process of photography devised by Captain Abney, and the Bolometer of Professor Langley, furnish us with excellent differential instruments by which we may compare at one place and moment the relative distribution of solar ... over the various parts of the spectrum.

If either of these observers could produce such a ... [illegible] ... that his results of to-day should be ... comparable with those ten or twelve years ... [illegible] ... would go far to obtain for us ... [illegible] ... regarding solar ... But ... [illegible] ... at any rate for some ... [illegible] ... the foregoing diagram ... [illegible] ... affected by the selective absorption of the components of the earth's atmosphere, for Professor Langley imagines that the ... [illegible]

... [illegible] ... the following ... [illegible] ... by the ... [illegible] ... regions of the spectrum in which in the shaded curve there are no ... and in the spectrum below it no corresponding dark lines ... [illegible] ... there is no selective ... [illegible] ... the energy from these ... [illegible] ... paper ... [illegible] ... the thermometer of a ... [illegible]

We shall ... [illegible] ... the problem ... [illegible]

... [illegible] ... the ... [illegible] ... exercises ... [illegible] ... the general ... [illegible] ... considerable



[illegible]

NOTES

[illegible] ... England ... [illegible] ... Hinde, ... [illegible]

Capt. Shelley. Altogether there were 248 members, representing Germany, Austria, Belgium, Spain, the United States of America, France, India (Mr. Blanford), Italy, Japan, Norway, Holland, Portugal, Roumania, Russia, Sweden, and Switzerland.

Mr. W. H. White, who has succeeded Sir N. Barnaby as Director of Naval Construction, has entered upon his duties at the Admiralty.

We regret to learn of the death of Walter Weldon, F.R.S., the eminent technical chemist, in his fifty-third year. Mr. Weldon's name is well known in connection with the Weldon process for the regeneration of the manganese peroxide used in the generation of chlorine, and with the consequent revolution in the production of bleaching lime, affecting favourably such important industries as the cotton and paper trades.

The Annual Exhibition of the Photographic Society was opened on Monday; the exhibits are up to the average of recent years.

Sir John Lubbock unveiled on Thursday last at Birmingham a marble statue of the late Sir Josiah Mason, which has been placed in the square between the Science College and the Town Hall. Referring to the Mason College, Sir John said that such an institution was all the more needed on account of the extraordinary manner in which science is still neglected in our public schools. There were, indeed, according to the Technical Commission, only three schools in Great Britain in which science is fully and adequately taught. The majority of schools devoted to it less than three hours out of forty. Scientific men claimed for it six hours out of [illegible], with the same number for mathematics, [illegible] languages, and two for geography, would still leave no less than sixteen for classics. He advocated the general teaching of science, because it would add to the interest and brightness of life, would purify and ennoble the character, and because, with our rapidly-increasing population, it was almost a necessity if our people were to be maintained in comfort. As regards the first point, it was quite a mistake to regard science as dry and uninteresting. Sometimes it might destroy a poetical idea, such as the ancient Hindoo theory of rivers—that [illegible] their beds [illegible] and sent them forth [illegible] pathways. But the real causes of natural phenomena were far more striking, and [illegible] [illegible] poetry than any that had occurred to the untrained imagination [illegible]. [illegible] happiness only, but in many cases [illegible] knowledge of science. Huxley had [illegible]. [illegible] it was perfectly certain [illegible] of every one of us would one day depend [illegible] winning [illegible] we should all learn [illegible] of the game. [illegible] very [illegible] that the [illegible] fortune of every one of us depends [illegible] knowing [illegible] the rules of a game infinitely more difficult [illegible] game which has been played for untold ages, every man and woman of us being one of the two players. The [illegible] world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of nature. The player on the other side is hidden from us. We know that his play is always fair, just, and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. To the man who plays well the highest stakes are paid with overflowing generosity, but one who plays ill is checkmated—without haste, but without remorse. The national necessity for science was most important. Even now we required to purchase food to the amount of 150,000,000*l.* a year. A century hence our coal would be approaching exhaustion, our population would be trebled, and we should require, to speak moderately, 400,000,000*l.* to pay for food. Nothing [illegible] of scientific training and appliances [illegible] these circumstances, to maintain our [illegible] and comfort. We had, in fact, the choice [illegible] suffering.

Mr. H. H. Johnston appeals in the [illegible] to make good the loss which Mr. H. O. [illegible] while embarking at Batavia for his exploring [illegible] Guinea. The boat which was carrying all his [illegible] ship suddenly capsized, and the unfortunate [illegible] seconds lost all his equipment, a loss which [illegible] take about 1000*l.* to replace. Mr. Forbes, [illegible] heard, was subsidised by the Royal, the [illegible] Australian Geographical Societies, while the [illegible] at Aberdeen has made a grant of [illegible] to help [illegible] What excellent work Mr. Forbes is capable of [illegible] is shown in his recently-published work on the [illegible] pelago. He lost no time in getting to [illegible] less there obtained on credit such articles as will [illegible] go on with his work, as according to the latest [illegible] on his way to New Guinea. Subscriptions may be [illegible] Secretary, Royal Geographical Society, [illegible]

In a few days the rock in the Hell Gate [illegible] New York harbour, from Long Island Sound, [illegible] blown up by a party under the command of [illegible] United States Engineers. For nine years the [illegible] cavation has been in progress. The rock has [illegible] combed with chambers, the surface being [illegible] [illegible] of rock, into which dynamite cartridges [illegible] fitted. Some 45,000 of these cartridges [illegible] been laid. The work of distributing the cartridges [illegible] July, 1884, and has just been completed, 275,000 lbs. of [illegible] having been used. The explosion is to be brought [illegible] means of an automatic detonator, placed upon [illegible] electric connection with the land being established. [illegible] expected that the explosion will pulverise the whole of [illegible] without making much commotion in the water, [illegible] beyond a distance of 1000 feet. The [illegible] removed, so as to make a channel 26 feet deep [illegible] Flood Rock and the adjacent rocks under water [illegible] destroyed over a space of nine acres.

The Rev. M. F. Billington, of Chaldon [illegible] [illegible], Dorset, writes to the *Times* under date September [illegible]: "This afternoon, at 5 o'clock precisely, we witnessed [illegible] [illegible] of 300 feet altitude, a most perfect reflection [illegible] of a ship in [illegible]. The Purbeck Hills, [illegible] [illegible] or fourteen miles to our south-west, shut out our [illegible] the sea in that direction, and in all our long experience [illegible] beautiful views of the coast line we have never before [illegible] this curious phenomenon. It lasted for about [illegible] and then slowly faded out of sight."

On September 26, between 8 and 9 p.m., a strange [illegible] similar to that described last week (p. 541) was again observed [illegible] many persons at [illegible] in Sweden. The [illegible] north-western [illegible] shone with a [illegible], there [illegible] was a cloud mass assuming the most remarkable forms. [illegible] [illegible] animals, trees, and shrubs were seen. [illegible] changed into an elephant, and soon a dog into a horse. [illegible] groups of dancers were seen, now being distinguished [illegible] women. Far [illegible] the cloud formed an oak forest, [illegible] of which was a [illegible], and [illegible] a [illegible]. At about 9.30 the cloud [illegible] into a mass, and the phenomenon disappeared.

The Royal Microscopical Society will meet at King's College, W.C., on Wednesday, the 14th inst., at eight o'clock, [illegible]

[illegible] —Dr. Maddox: On the Feeding [illegible] D. Rossiter: On the Gizzard of [illegible]

[illegible]

Indiana, North America, presented by Mr. F. J. Thompson; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Great Bird of Paradise (*Paradisea apoda*) from the Aru Islands, a Common Cormorant (*Phalacrocorax carbo*), British, an Emu (*Dromaeus novae-hollandiae*) from Australia, a Gigantic Salamander (*Megalobatrachus maximus*) from Japan, deposited.

## OUR ASTRONOMICAL COLUMN

THE SATELLITES OF URANUS AND NEPTUNE.—In Appendices I. and II. of the Washington Observations for 1881, Prof. Asaph Hall has published the results of his investigation of the orbits of the outer satellites of Uranus, *Oberon* and *Titania*, and the satellite of Neptune. The satellites of Uranus were among the first objects observed with the 26-inch refractor of the Naval Observatory, after it was mounted in November, 1873. The first series, during the oppositions of 1874 and 1875, were [illegible] by Prof. Newcomb, with the view to the determination of the mass of the planet, and the formation of tables of the motions of the satellites, which were published in the Washington Observations for 1873. Remarking that as the earth would be nearly in the plane of the orbits in the year 1882, and observations made about that period would permit of a good determination of the position of this plane, Prof. Hall commenced a new series in March, 1881, which were continued through the four oppositions until the end of May, 1884; these observations were made with magnifying powers of 600 and 880, in fair conditions of the atmosphere [illegible] with the Washington instrument. A comparison of the measures with Prof. Newcomb's tables showed that these tables required [illegible] small corrections, which were found by equations of condition [illegible]. It is to be mentioned that the tables were founded mainly upon Prof. Newcomb's own measures; those by Prof. Hall in the years 1875 and 1876 are included in the present discussion.

For the position of the planes and inclinations of the orbits of the satellites, Prof. Hall finds:—

[illegible]

[illegible] from 1883.0.

[illegible] mass of Uranus by the observations of [illegible], combining the values with the respective weights, the final result is $\frac{1}{22682}$. [illegible] smaller than those previously obtained. Prof. Hall [illegible] as he could obtain with the [illegible] refractor, and he does not consider [illegible] by a continuation of the [illegible]. He [illegible] the oppositions of the [illegible] 1882, which were [illegible] favourable for [illegible] careful examination on [illegible] planet no known satellites, [illegible].

[illegible] be sensibly [illegible].

Prof. Hall's [illegible] of the orbit of the satellite of Neptune [illegible] his own observations during the oppositions of 1875 [illegible] 1876 and those of 1881—84, [illegible] Prof. Holden's measures in the [illegible] 1874 [illegible] and has also discussed [illegible] and Marth taken at Malta in 1863 and 1864. [illegible] The following are the principal results:—

[illegible]

[illegible] from 1884.0.

[illegible] 1881—84 with those of Lassell [illegible] mean solar [illegible] by Mr. Hind, which was adopted by Prof. [illegible], the small difference would [illegible] the position of the satellite [illegible] and Prof. Hall [illegible] correction is required.

The values of the [illegible] Neptune from his measures at different oppositions, and [illegible] of Lassell and Marth and of Holden [illegible]. The mean result from Hall's own observations $\frac{1}{19092}$, he remarks that his distances are generally smaller than those of other observers, and believes that, in order to eliminate the effect of such personal equation from the determination of the mass of a planet, the only way will be to increase the number of observers, and to take a mean of their results. Hall's value agrees very nearly with that found by Prof. Newcomb, $\frac{1}{19380}$.

On [illegible] nights examinations of the region about Neptune were made, but no other satellite was detected.

VARIABLE STARS.—The following Greenwich times of [illegible] minima of Algol have been deduced from elements [illegible]:

| | | h. m. | | | h. m. |
|---|---|---|---|---|---|
| November | 8 | 15 7 | December | 7 | 7 16 |
| | 11 | 11 5[illegible] | | 18 | 15 31 |
| | 14 | 8 45 | | 21 | 15 22 |
| | 17 | 5 34 | | 24 | 10 11 |
| | 28 | 16 49 | | 27 | 9 0 |
| December | 1 | 15 38 | | 30 | 5 49 |
| | 4 | 1[illegible] 27 | | | |

[illegible] h. 12 9. [illegible] Argelander's formula of sines makes a maximum of *Mira Ceti* due on December 19, but it may probably occur earlier.

## ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, OCTOBER 11–17

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on October 11*

Sun rises, 6h. 2[illegible]m.; souths, 11h. 4[illegible]m. 41·8s.; sets, 17h. [illegible]m.; decl. on meridian, 7° 11′ S.: Sidereal Time at Sunset, 18h. [illegible]m.

Moon (three days after New) rises, 9h. [illegible]m.; souths, 14h. 28m.; sets, 19h. [illegible]m.; decl. on meridian, 15° 15′ S.

| Planet | Rises h. m. | Souths h. m. | Sets h. m. | Decl. on meridian |
|---|---|---|---|---|
| Mercury | 5 55 | 10 35 | 17 15 | 4 35 S. |
| Venus | 10 17 | 14 23 | 18 29 | 21 [illegible] S. |
| Mars | 0 11 | 7 [illegible] | 15 27 | 17 41 N. |
| Jupiter | 3 31 | 10 10 | 19 35 | 3 3[illegible] N. |
| Saturn | 21 5* | 5 16 | 13 2[illegible] | 21 [illegible] N. |

* Indicates that the rising is that of the preceding day.

*Phenomena of Jupiter's Satellites*

| Oct. | h. m. | | Oct. | h. m. | |
|---|---|---|---|---|---|
| 12 | 4 37 | IV. ecl. disap. | 14 | 4 50 | I. tr. egr. |
| 13 | 4 51 | I. ecl. disap. | 19 | 4 7 | II. tr. ing. |

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

| Oct. | h. | |
|---|---|---|
| 11 | 12 | Venus in conjunction with and 6° 21′ south of the Moon. |
| 10 | 10 | Mercury in superior conjunction with the Sun. |
| 17 | [illegible] | Venus at greatest distance from the Sun. |

## GEOGRAPHICAL NOTES

ACCORDING to the report by Lieut. Wissmann on his last exploration in the Congo region, the Lower Kassai constitutes a magnificent fluvial artery, frequently of enormous breadth, and leads without obstacle into the heart of the new Congo State. Between the station of Kwamouth and the confluent of the Lulua and above the station of Luluaburg the Kassai, with a breadth of about 600 kilometres, is everywhere open for navigation. It runs through a country of wonderful fertility, presenting alternately plains and virgin forests [illegible] population. With about one [illegible] received everywhere with eagerness [illegible] posed to trade. During the forty-two [illegible] voyage from Luluaburg to Kwamouth the [illegible] tion was excellent. There was no loss [illegible] natives were drowned in the [illegible] white men and the 200 Negroes of the Exp[illegible] good health at Léopoldville on July 16.

THE current number of *Petermann's* [illegible] the conclusion of M. Thoroddsen's paper [illegible] interior of Iceland. It supplies [illegible] the observations of the writers, [illegible] tions, heights, &c., hydrography, climate, glaciers, botany, and zoology of the [illegible] [illegible] describes, with a large map, [illegible] in Central Africa between 187[illegible] and 188[illegible] graphical information for the month, and [illegible] the number.

THE most interesting contribution, [illegible] this month is a short prefatory [illegible] geographical house of Perthes of Gotha, [illegible] centenary of its foundation. In 18[illegible] the [illegible] [illegible] was published by Perthes, and a [illegible] large atlas by Prof. Heusinger. Under the [illegible] Wilhelm Perthes, who was head of the [illegible] 18[illegible] and 185[illegible], the publication of the [illegible] graphical and cartographical character. In the [illegible] edition of Stieler's Atlas, [illegible] between 182[illegible] and 183[illegible] a supplement of [illegible] [illegible] kept up to date, and the number of the maps [illegible] was 84, grew in 1871 to 90, and in 18[illegible] to [illegible] number of [illegible], old and new, [illegible] Berghaus (1797–1884), Spruner and [illegible]. In 18[illegible] Berghaus's great atlas of the [illegible] appeared. It was a financial failure, [illegible] the house [illegible], and laid the foundation of [illegible] fame. In 18[illegible] the publication of the [illegible] Atlas in [illegible] maps was completed. [illegible] Spruner's Historical-geographical Atlas appeared, [illegible] lowed by various editions. Wilhelm Perthes [illegible] Bernhard [illegible] reigned in his stead [illegible] leaving a posthumous son, the present [illegible] mann, who died in 1878, commenced his [illegible] [illegible] in 1855. The publications of the house [illegible] are well-known to all geographers; [illegible] Year Book," and Behm and Wagner's "[illegible] Globe," are works of world-wide celebrity.

THE [illegible] has, after an absence of [illegible] Danish exploring expedition to the east coast [illegible] under Lieutenants Holm and Garde, returned [illegible] the ship *Constance* from Godthaab. We have [illegible] given particulars of the progress of this [illegible] object of which was to penetrate as far [illegible] coast as possible, and to attempt to reach [illegible] [illegible] known to exist between latitudes 6[illegible] and [illegible] expedition has fulfilled all expectations [illegible] valuable scientific material, Lieut. Holm [illegible] lat. 65° 6′, the highest point reached [illegible] northernmost ever reached by Europeans. [illegible] a [illegible] many very valuable geographical [illegible] graphical discoveries, having spent [illegible] [illegible] before visited by Europeans [illegible] the stretch of coast explored, King Christian IX.'s Land.

A [illegible] has travelled [illegible] Southern China [illegible] *Tourisme* [illegible] Lao-Kai [illegible] to Yunan. [illegible] Lao-Kai, on the Tonquin border [illegible] refers to the various [illegible] China, [illegible] he thinks that France [illegible] the Chinese [illegible] then describes the [illegible] the head of the [illegible] road to the plains of Yunan [illegible]

[illegible]

from the Lower Greensand by means of deep borings at any great distance from its outcrop. Even if Lower Greensand occur at all in such places, it will probably be in reduced thickness, and therefore with reduced water-capacity.

*American Evidences of Eocene Mammals of the "Plastic Clay" Period*, by Sir Richard Owen, K.C.B., F.R.S., G.S., &c.—In the year 1843 a fragment of a lower jaw with one entire molar of a mammal was dredged up off the Essex coast. A canine tooth of the same was found in a well-sinking near Camberwell, in piercing the "plastic clay." The author had described the above as belonging to an animal of the Lophiodont family, and proposed for it the generic name Coryphodon. Shortly afterwards De Blainville had noticed certain fossils as "probably Coryphodont," but had referred them to *Lophiodon anthracotherium*. Ten years later Prof. Hebert had recognised two species of *Coryphodon* in the plastic clay of France. Explorations by Leidy, Marsh, and Hayden, in the "Mauvaises Terres" of Nebraska had led to the discovery of a large hoofed mammal allied to *Coryphodon*, to which the name *Titanotherium* had been given, and Prof. Cope has now recognised, from Evanstown, Wyoming, seven species of *Coryphodon*. From these materials, which have been rendered accessible to European palæontologists by the superb volume of reports recently issued by the United States Government, the author is enabled to give a general description of this family of hoofed mammals of large size which flourished in early Eocene times. To the details of this the major part of the paper is devoted.

*Some Results of the Crystallographic Study of Danburite*, by Dr. Max Schuster.—In studying the characters of the faces and the structure of the Danburite crystals found in Switzerland the author has met with vicinal faces of a peculiar kind, for which he proposes the term "transitional faces" (*Tschermak Min. Mittheil.*, vi., 1884, p. 511). Attention is called to the fact that these faces are easily affected by those causes which produce an unequal development of faces otherwise symmetrically disposed, and an illustration is given of the way in which their indices are numerically related to those of the principal faces of the crystal.

*Notice of an Outline Geological Map of Lower Egypt, Arabia Petræa, and Palestine*, by Edward Hull, LL.D., F.R.S., F.G.S. —The map exhibited was enlarged from that which accompanies the author's book, "Mount Seir, Sinai, and Western Palestine," giving a narrative of the expedition sent out into these countries by the Palestine Exploration Society in 1883-84. It embraces a region extending from the valley of the Nile on the west to the table-land of Edom (Mount Seir) and Moab, including the Jordan, Arabah Valley, and the mountains of Sinai. Its northern limit is the Lebanon. The main lines of fault and dip of the strata are also indicated. A topographical and geological map of the Arabah Valley on a scale of about six miles to one inch was in preparation, and would accompany the Geological Report now in the press for the Palestine Exploration Society.

*A Preliminary Note on a New Fossil Reptile recently discovered at New Spynie, near Elgin*, by Dr. R. H. Traquair, F.R.S.—Of this most important fossil the author had as yet only seen a photograph submitted to him by Prof. Judd, the President of the Section. This photograph represents pretty nearly a vertical longitudinal section of a reptilian skull, of which one very prominent feature is the presence of a large conical tusk in the upper jaw, projecting downwards and forwards, immediately behind the premaxillary part of the skull. This tusk is seen only in impression, but the cast of the internal cavity which is well shown indicates that it grew from a permanent pulp. No evidence of any other teeth is visible, and the whole appearance of the skull as seen in the photograph, with the position and shape of the tusk, indicate that the reptile here represented, if not actually belonging to the genus Dicynodon, is certainly a member of the group of Dicynodontia. Geologists will not underrate the importance of this discovery in its bearing on the question of the age of the reptiliferous sandstone of [illegible]

*On the Average Density of Meteorites compared* [illegible] *the Earth*, by the Rev. E. Hill, M.A., F.G.S.—[illegible] density of the meteorites which fall on the earth [illegible] be calculated. Different methods give as result[illegible] 4·84, 5·71, the last value being influenced by th[illegible] particularly large metallic specimen. The average de[illegible] earth is usually regarded as 5·6. Meteorites are sampl[illegible] materials of space. A mass of them would aggregate [illegible] body of density not widely differing from that of the [illegible] The densities of the other planets are not inconsistent wi[illegible] like origin. Consequently any theory of the genesis of the ea[illegible] from pre-existing materials involves a probability that an [illegible] portant part of its nucleus is metallic.

*On the Occurrence of Lower Old Red Conglomerate in* [illegible] *Promontory of the Fanad, North Donegal*, by Prof. Ed[illegible] Hull, LL.D., F.R.S., Director of the Geological Survey [illegible] Ireland.—The district in which the Old Red Cong[illegible] occurs is formed of ridges and valleys of metamorphic [illegible] consisting of beds of quartzite, schist, crystalline limest[illegible] trap, chiefly diorite. It lies between Lough Swilly and M[illegible] Bay, and is washed on the north by the waters of the [illegible] The remarkable tract of the Old Red Conglomerate [illegible] discovered by the officers of the Geological Survey, is fa[illegible] from any mass of the same formation, and it is unre[illegible] on any geological map hitherto published. The beds [illegible] red and purple sandstones and conglomerates, made [illegible] of quartzite pebbles and blocks, but also containing [illegible] limestone and trap; all derived from the surrounding [illegible]phic series. They occupy an area of over two miles [illegible] and half a mile across, extending along the northern [illegible] Knock Alla, a ridge of quartzite which traverses the pro[illegible] from side to side. The beds dip against the base of the [illegible]tain, against which they are let down by a large fault, a[illegible] terminate along their northern edge by an unconformable [illegible] position on beds of quartzite and limestone. They rea[illegible] thickness of about 800 feet. From the position of these [illegible] becomes evident that they are unconnected with an[illegible] recognised basins of Lower Old Red Sandstone, either [illegible]land or Ireland, and may, therefore, be regarded [illegible] been formed in an isolated basin, which, following the [illegible] of Dr. Geikie, I may be allowed to name "Lake [illegible] The tract will be a new feature on geological [illegible] Ireland.

*On Bastite-Serpentine and Troktolite in Aberdeen* [illegible] *a Note on the Rock of the Black Dog*, by Prof. T. G. [illegible] D.Sc., LL.D., F.R.S., Pres.G.S.—Bastite-serpentine [illegible] some time since by Prof. Heddle) occurs near Belhelvie [illegible] the shore near the Black Dog. The author describes [illegible]scopic structure of this, showing that it consists of [illegible] its alteration products, enstatite in various stages of [illegible] and a mineral of the spinellid group. Associated [illegible] the Belhelvie district is a fairly normal troktolite, con[illegible] a plagioclastic felspar allied to anorthite, olivine, m[illegible] altered, and a little diallage. It closely resembles [illegible] Volpersdorf rock, but has rather less magnesia [illegible] alumina, corresponding chemically more nearly with a [illegible] scribed by the author from Coverack Cove, Cornwall. [illegible] opinion that the two rocks differ somewhat in age [illegible] probably the earlier was still at a high temperature [illegible] latter was intruded, and he inclines to the view that [illegible]pentine is the older rock of the two. The Black Dog [illegible] incorrectly described as consisting of "crystals of *tal*[illegible] such confusion as to form both a tough and hard rock [illegible] rock really consists of quartz, sillimanite, two kinds [illegible] an iron oxide (hematite?), and most probably some [illegible] with perhaps a little kyanite. In short, the rock prese[illegible] close resemblance under the microscope to some spec[illegible] the well known "cordierite gneiss" of Bodenmais.

*On the Re-discovery of Lost Numidian Marbles in Al*[illegible] *Tunis*, by Lieut.-Col. Playfair, H.M. Consul-Gen[illegible] Algeria and Tunis.—The author explained that the na[illegible] was a misnomer, as they are not found within the [illegible] Numidia proper, but in the province of Africa and in Ma[illegible] Most of the "Giallo antico" used in Rome was [illegible] [illegible] the modern Chemton, in the valley [illegible] Med[illegible] of which are now being [illegible] work[illegible]pany, but the most [illegible] valu[illegible] Kleber, in the [illegible] Oran, [illegible] of the M[illegible] exists [illegible] interru[illegible] which the [illegible] their beauty [illegible] mens described in this communication were collected by Mr. J. G. Buchanan, during the voyage of the *Challenger*. The islands have been described by Darwin in his "Geological Observations on Volcanic Islands" (2nd edition, p. 27). The author, after having explained the geological structure, gives lithological descriptions of the chief types of the rocks, which may be referred to the phonolites (St. Michael's Mount). These phonolites are composed of sanidine, augite, nepheline, hornblende, magnetite, nosean, and titanite. The rocks of Rat Island are basalts with nepheline. The constituent minerals are augite and olivine. The ground-mass is almost entirely composed of nepheline. Biotite and apatite occur as accessory constituents. The little island known as Platform Island is also basaltic, with a doleritic texture. It is composed of labradorite, augite, olivine, magnetite, and biotite. This rock has undergone alterations.

*Preliminary Note on some Traverses of the Crystalline District of the Central Alps*, by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., Pres. G.S.—During the past four years I have made several traverses of the Central Alps from north to south, and venture to lay before the Section the general results as bearing in some respect on the geology of the Highlands. (1) The ordinary rules of stratigraphy as learnt from most lowland districts are commonly quite inapplicable to the Alps. The most highly crystalline and the older beds often form the higher parts of a mountain region, the newer the lower. The newer beds frequently appear to underlie and dip regularly beneath the older. Gigantic folds, overturns, and overthrust faults abound. The true stratigraphy of a district can only be worked out by the exercise of patient and cautious induction from observations extended over a wide area. (2) The non-crystalline rocks of the Alps are of various ages. There are some of Carboniferous age, but the great period of continuous deposition generally begins with some part of the Trias. The conglomerates, which often occur at the base of the non-crystalline deposits, indicate that the principal metamorphism of the crystalline series was anterior to both these epochs. There is at present no reason to suppose that either in the Central Alps or for some distance on each side are there any representatives of the earlier Palæozoics. I believe that the conglomerates at the base of the Carboniferous contain fragments of the later crystalline rocks of the Alps as well as of some of the earlier—though I do not assert that these crystalline rocks have undergone no modifications since Carboniferous times. (3) In the heart of the principal Alpine chains, and apparently at the base of everything, are coarsely crystalline gneisses. These differ little from granites, except that they generally—almost always—exhibit a certain foliation, and occasionally seem to be interbedded with thin seams of micaceous schists or flaggy fine-grained beds. (4) On examination we find reason to believe that both the latter are generally due to crushing. Their strike agrees with that of the apparent foliation in these older rocks, and with that of a foliation which is also present in the newer crystalline rocks. This corresponds with the strike of the main physical features of the district, and with the cleavage in the included troughs of sedimentary rock. It runs for great distances with remarkable uniformity. (5) This apparent foliation is due to the development of extremely thin films of a micaceous mineral. In many cases it causes the rock to bear the aspect of a highly micaceous schist; yet, on examining a transverse section, the rock is distinctly seen to be a crushed gneiss—*i.e.* though so conspicuous, it is a mere varnish. As it thus differs materially from a true foliation, it would be convenient to give it a name, and I should propose to call it the "sheen surface." It is, in fact, a kind of "cleavage foliation," that is, a foliation due to cleavage, and subsequent to it. (6) The pressure which has produced this "sheen surface" [illegible] in many cases affected the orientation of the minerals, [illegible] are present in the true "foliation" layers of the [illegible]tinctly foliated, *i.e.* mineral-banded, rocks. (7) In [illegible] schists very commonly the "sheen sur[illegible] [illegible] with the original foliation surface, as in the [illegible] sometimes does with the bedding. This is [illegible] the [illegible] of the great folds often make a very [illegible] [illegible]. (8) Thus a non-foliated crystalline [illegible] some extent foliated by pressure (fol[illegible] [illegible] mineralisation) *i.e.* some gneisses [illegible] granites, some schists out of other [illegible] earlier foliation, or it may [illegible] [illegible]endent and more fissile [illegible] to pass into granite, because a rock which is now, both macroscopically and microscopically, a gneiss may prove to be a granite which has in some parts yielded to pressure more than in others. (9) As we pass outwards from the great central granitoid masses we come to gneisses and schists where the evidence of some kind of stratification becomes more marked; bands of crystalline limestone, quartzite, and granulite being associated with mica-schist of many kinds—simple, garnetiferous, staurolitic, actinolitic, and the like—the bands of different mineral character and composition varying from mere streaks to layers up to many yards in thickness. In fact the above-named rocks are associated exactly as limestones, sandstones, and clays are associated in the ordinary sedimentaries. (10) Although the crushing of a crystalline rock *in situ*, or the squeezing and shearing of a breccia or conglomerate of crystalline fragments, occasionally gives rise to local difficulties, these are on a small scale, and sedimentary beds belonging to the Palæozoic or later periods of deposition are generally readily distinguishable from the whole of the crystalline series. Though folded and faulted in the most extraordinary manner, the members of the two series can generally be separated and in the Alps there is no evidence of a mingling of the one with the other in the process of rolling out or squeezing together; so that, after patient study and microscopical examination, we can generally decide without hesitation whether a particular set of rocks has originated from the crystalline or the sedimentary series. I do not say that we can always decide whether a schist or a gneiss has originated from an igneous rock or from an older schist or gneiss, but I think that in the Alps we can say that it has originated from one of these. Fortunately, intrusive rocks are very rare in the Palæozoic and later deposits in this part of the Alps. (11) Thus, although the Tertiary metamorphism of the Alpine rocks is very important, it is more pretentious than real, and its effects seem to have been the greatest where it has found a rock already crystalline to act upon. Hence I believe that every true gneiss and schist in the Alps is much older than the Carboniferous, and is probably older than any member of the Palæozoic period.

*The Direction of Glaciation as ascertained by the Form of the Striæ*, by Prof. H. Carvill Lewis.—As there seemed to be a disagreement between certain Scotch geologists and the Irish geologists regarding the inferences as to direction of glaciation to be deduced from the form of glacial striæ, the author was led to bring forward some observations of his own, made in America and in Great Britain, which threw light upon the disputed point. Well-preserved striæ are frequently blunt at one end and tapering at the other, the shorter ones sometimes resembling the characters used in the cuneiform inscriptions. This form may be seen in striæ of all sizes—from those several yards in length, when the blunt end may be an inch or more in breadth, to the finest scratches, where a microscope is necessary to detect any difference between the two ends. As shown in the Reports of the Boulder Committee of the Royal Society of Edinburgh (Fifth Report, pp. 18-20, 29, 58; Seventh Report, p. 18) and elsewhere, certain Scotch geologists regard the blunt end as the point of impact of the striating agent, and as therefore facing the direction from which the motion came. On the other hand the Irish geologists ("Memoirs of the Geological Survey of Ireland," Explanation to sheets 86, 87, 88, p. 55; Explanation to sheet 193, p. 18, &c.) interpret the shape of the striæ as indicating motion in the opposite direction, believing the tapering end to point to the direction from which glaciation proceeded. The point at issue is of importance, especially in outlying islands and elsewhere, where other indications of the direction of glaciation fail. In Pennsylvania, which is crossed from east to west by the terminal moraine of the great ice-sheet, and where the glaciation is uniformly in a southward direction, the author had observed that the blunt ends of the striæ, where flat surfaces were studied, were always to the south ("On the Terminal Moraine in Pennsylvania and Western New York." Report Z, Second Geological Survey of Pennsylvania, pp. 33, 85, 86, 107, 275). In certain instances the mode of formation of the striæ was also indicated by their shapes, which showed that a stone pushed along under the glacier had ground in deeper and deeper until in some cases it stopped or hopped out, in other cases was ground down to another cutting edge, and in others *turned over*, and began its work of engraving by a fresh and sharp corner. The peculiar gorges at the farther end of certain striæ showed a sort of slow rocking motion in some stones before they finally turned over. The author's observations in Ireland, both at localities where there could be no doubt as to the direction of glacial movement, and at localities where such direction was not previously known, led to conclusions entirely in harmony with those already reached in Pennsylvania and with those held by the Irish geologists. One of the best examples falling under the former category was among the local glaciers in the mountains of the Dingle promontory, a region not invaded by the great confluent ice-sheet of central Ireland. The striated beds of these small glaciers, beginning in a "corry" and bounded below by a semicircular terminal moraine, are beautifully defined and afford good opportunities for striæ study. It was found that *on upward slopes or on flat surfaces the striæ as a rule are blunt at the end toward which the motion was directed, but that in downward slopes the reverse is generally the case.* While this rule does not hold good for every individual scratch at a given locality, it has been found most useful when applied to striated surfaces in general. At Glengariff, where some finely striated surfaces occur, a number of tracings were taken directly from the rock, which clearly show the broad ends of most of the striæ to be to the south, the direction towards which the glacial stream advanced. Similar observations were made at several localities south of the Shannon. Finally, as an instance where the direction of glaciation was previously unknown, certain striæ were described which the author had observed on the top of the cliffs facing the Atlantic at Kilkee. These point N. 55° W. and S. 55° E., and the question to be determined was whether the glaciation proceeded from the Atlantic towards the land or whether it was north-westward and out to sea. The form of the striæ [illegible] decided it. Their broad blunt ends were as a rule toward the north-west, the surface being horizontal, a fact which, taken in connection with other observations [illegible] about the mouth of the Shannon, shows that a great ice stream had flowed westward along the valley of the Shannon and had [illegible] into the sea.

*The Geology of the [illegible]*, by B. N. Peach, F.R.S.E., and J. Horne, F.R.S.E. [illegible]

[illegible]

of similar mechanical movements [illegible] exhibits the parallel lineation like [illegible] same direction over a vast area, while the [illegible] along these lines. From a consideration [illegible] the authors inferred that regional [illegible] necessarily be confined to any particular [illegible] the planes of foliation or schistosity [illegible] been subjected to regional metamorphism [illegible] enormous mechanical movements which [illegible] changes in crystalline and clastic rocks.

*The Highland Controversy in British Geology [illegible] and Consequences*, by Chas. Lapworth, LL.D. [illegible] Geology and Physiography, Mason College [illegible] author gave a *résumé* of the views of the earlier [illegible] the geological age and possible mode of [illegible] land metamorphic rocks; and sketched [illegible] progress of the controversy between Sir Rod[illegible] followers on the one hand, and Prof. Nic[illegible] the other, till its temporary close in 1861 [illegible] the Highland Memoir of Murchison and [illegible] reviewed the reopening of the controversy [illegible] and the work of the Archæan geologists [illegible] cation of Dr. C. Callaway's paper in 1883 [illegible] view of the great physical break between the [illegible] and the Eastern or Upper Gneissic series [illegible] correct, but the so-called Eastern gneiss [illegible] erected into a new Archæan system, the [illegible] Arnaboll gneiss as its lower member. The [illegible] summary of his own views as deduced from [illegible] the Durness-Eriboll district in 1882 and 1883, and 1884, illustrating these by coloured maps and [illegible] that (exception being made of the [illegible] stones) the only rock formations in the Durness [illegible] as Nicol originally contended: (1) The Archæan [illegible]; and (2) The Palæozoic quartzites [illegible]

[illegible]

mica and quartz, are developed. The most intense mechanical metamorphism occurs along the grand dislocation (thrust) planes, where the gneisses and pegmatites resting on those planes are crushed, dragged, and ground out into a finely-laminated schist (*Mylonite*, Gr. *mylon*, a mill) composed of shattered fragments of the original crystals of the rock set in a cement of secondary quartz, the lamination being defined by minute inosculating lines (fluxion lines) of kaolin or chloritic material and secondary crystals of mica. Whatever rock rests immediately upon the thrust-plane, whether Archæan, igneous, or Palæozoic, &c., is similarly treated, the resulting mylonite varying in colour and composition according to the material from which it is formed. The variegated schists which form the transitional zones between the Arnaboll gneiss and Sutherland mica-schists are all essentially mylonites in origin and structure, and appear to have been formed along many dislocation planes, some of whieh still show between them patches of recognisable Archæan and Palæozoic rocks. These variegated schists (Phyllites or Mylonites) differ locally in composition according to the material from which they have been derived, and in petrological character according to the special physical accidents to which they have been subjected since their date of origin—forming frilled schists, veined schists, glazed schists, &c., &c. The more highly crystalline flaggy mica-schists, &c., which lie generally to the east of the zones of the variegated schists, appear to have been made out of similar materials to those of the variegated schists, but to have been formed under somewhat different conditions. They show the fluxion-structure of the mylonites; but the differential motion of the component particles seems to have been less, while the chemical change was much greater. In some of these crystalline schists (the augen-schists) the larger crystals of the original rock from which the schist was formed, are still individually recognisable, while the new matrix containing them is a secondary crystalline matrix of quartz and mica arranged in the fluxion-planes. While the *mylonites* may be described as microscopic pressure-breccias with fluxion-structure, in which the inter-titial dusty, siliceous, and kaolinitic paste has only crystallised in part; the *augen-schists* are pressure-breccias, with fluxion-structure, in which the whole of the interstitial paste has crystallised out. The *mylonites* were formed along the thrust-planes, where the two superposed rock-systems moved over each other as solid masses; the *augen-schists* were probably formed in the more central parts of the moving system, where the all-surrounding weight and pressure forced the rock to yield somewhat like a plastic body. Between these augen-schists there appears to be every gradation, on the one hand to the mylonites, and on the other to the typical mica-schists composed of quartz and mica. Like the mylonites, the crystalline augenites and micalites present us with local differences in chemical composition (calcareous, hornblendic, quartzose, &c.), suggestive of Archæan, igneous, or Palæozoic origin. They also show similar structural varieties due to secondary physical changes (frilled, veined, glazed, &c.), as well as others due to the presence of special minerals (garnet, actinolite, &c., &c.).

*On certain Diatomaceous Deposits (Diatomite) from the Peat of Aberdeenshire*, by W. Ivison Macadam, F.C.S., F.S.C., &c., Lecturer on Chemistry, School of Medicine, Edinburgh.—The material was found below the peat in certain districts of Aberdeenshire, but principally in the basin in which lie Lochs Kinnord and Dawin. After removal of the surface peat-fuel, the lower and more highly mineral portion was cut in blocks and air-dried. The substance then consisted of almost pure Diatomacea bound together by the remains of Spragnum, Equisetacea, &c. Besides being found underlying peat the substance was also obtained on the shores of Loch Kinnord, and the mo e pure Diatoms were thickly distributed over the bottom of the deeper [illegible]tions of the lake; these latter, however, from the want of [illegible]birding obtained from the marsh plants above mentioned could [illegible] rendered readily available for market. An interesting [illegible]arding these deposits was that whilst in Loch Kinnord [illegible] supply of the Diatoms could be obtained, in the [illegible] Loch Dawin scarcely a single Diatom (recent or [illegible]). This was probably due to the fact that whilst [illegible] of Loch Kinnord flowed from hills consisting [illegible] disintegrated granite, and consequently [illegible]able portion of soluble silica, the Loch [illegible]ined from hornblendic mountains, and [illegible] in solution. The material was [illegible]facture of dynamite, and a con[illegible] [illegible]warded to the works for this purpose. Unfortunately, however, dynamite had fallen to a great extent out of use, being replaced by the more powerful blasting gelatine, and thus what had at one time appeared as if it would prove an important local industry had entirely fallen away. Other uses, however, could be found for the material, such as the manufacture of ultramarine, for which, from the very small proportion of iron present, the diatomite has more especially to be recommended. As an absorbent it was of fully double the value of the ordinary German varieties of "kieselguhr."

*On Some Recent Earthquakes on the Downham Coast, and their Probable Causes*, by Prof. G. A. Lebour, M.A., F.G.S.—For the last two years frequent slight shocks, resembling those of earthquakes, and accompanied by rumbling noises, have been felt at Sunderland. Much discussion has arisen as to the cause of these, but that they are due to natural causes is now quite certain. Sunderland stands upon magnesium limestone, from 300 to 400 feet thick beneath the town; the rock is riddled with cavities of every size, some so small as to give a vesicular character to the stone, some large and forming true caverns. These cavities are partly due to the washing out of marly matter, partly to solution of the limestone. Every thousand gallons of Sunderland water contains one pound of stone; in this manner about forty cubic yards of magnesian limestone are yearly pumped up by the Water Company, and of course a much larger quantity is removed by natural channels. This action enlarges the cavities; the sides and roof fall in, thus accounting for the shock. The same explanation applies to the "breccia gashes" which are exposed along the shore. These are fissures filled with breccia. Quite recently similar shocks to those here referred to have been observed at Middlesborough. Pumping the brine from the salt deposits, 1000 to 1200 feet below the surface, may produce cavities into which the rock falls.

*Some Examples of Pressure-Fluxion in Pennsylvania*, by Prof. H. Carvill Lewis.—The three localities in Pennsylvania described in this paper lie in an area which had been especially studied by the author for some years back and had led him to conclusions similar to some of those recently announced as the result of studies in North-Western Scotland, which have justly attracted widespread attention. (1) a zone of ancient crystalline rocks extends across South-Eastern Pennsylvania, near Philadelphia, which is generally believed to underlie the lowest Cambrian strata and to be of Archæan age. This zone is about a mile wide where it crosses the Schuylkill River, south of Conshohocken, and it is from this point to Westchester, some twenty miles westward, that the present remarks especially apply. Although in many portions exhibiting a distinct gneissic lamination, the rocks of this zone are held by the author to be of purely eruptive origin, consisting of syenites, acid gabbros, trap granulites, and other igneous rocks, often highly metamorphosed. It is the outer peripheral portion of this zone to which attention is here directed. While the rocks are massive in the centre, this outer portion has been enormously compressed, folded, and faulted, with the result of producing a tough-banded, porphyritic *fluxion gneiss* identical with the "milonite" of Lapworth or the "sheared gneiss" of Peach and Horne. So perfect is the fluxion structure that the rock resembles a rhyolite. As in the "banded granulite" of Lehmann, elongated feldspar "eyes" lie in flowing streams of biolite grains and broken quartz, the streams often parting and again meeting around the porphyritic "eyes." Occasional crystalline eyes of hornblende remain, but most of it has been converted into biotite. A point of especial interest is that the feldspar of the eyes is quite colourless and free from inclusions, like the sanidine of recent lavas, while, on the other hand, the feldspars of the inner and massive portions of the zone, out of which this outer portion has been reformed by pressure fluxion, are full of inclusions and have the "dusty" appearance so common in ancient feldspars. The fresh-looking feldspar eyes are therefore believed to have been subsequently formed as a result of a *recrystallisation* of the old material under the influence of *pressure fluxion*. In similar manner the biotite has been made out of the old hornblende, garnets have been developed, and the quartz has been granulated and optically distorted by pressure. The influence of pressure is also seen in certain Cambrian strata in the immediate vicinity, where a sandstone containing cylindrical casts of *scolithus linearis*, apparently identical with the "pipe-rock" of North-Western Scotland, has, like it, been compressed to such a degree that the vertical casts are flattened out and elongated in the direction of lamination to several times their original length. In the same sandstone quartz pebbles have been pulled out and flattened, while sericite has been largely developed along the cleavage planes. The pressure can be shown to have been directed mainly from the south-east. (2) The second locality is in the midst of the Laurentian area of Buck's County, and is known as Van Artsdalen's Quarry. A mass of crystalline limestone is here mingled with an eruptive diorite in such manner as to show that it had actually flowed like an igneous rock, and had caught up inclusions. The results of extreme metamorphism are exhibited in the development in the limestone of graphite, wollastonite, and other minerals. The chemical changes and interchange of elements which might result from a loosening of molecular combinations under extreme pressure and their subsequent "regulation" into new compounds were discussed as among the phenomena of mechanical metamorphism. (3) As an American instance of the conversion of an intrusive diabase dyke into amphibolite schist, analogous to the case recently described by Teall, a long narrow belt of sphene-bearing amphibolite schist in the City of Philadelphia was adduced. This belt with distinctive mineralogical characters cuts across the metamorphic mica schists of the region unconformably, and is believed by the author to be a highly metamorphosed intrusive dyke of Lower Silurian age. The original augite or diallage has been completely converted into fibrous hornblende, and the influence of pressure is shown in the perfectly laminated character of the schist in the close foldings produced, and in the minute structure of the rock. Some interesting details of the latter having been photographed, diagrams constructed from these were exhibited. These showed that the rock was traversed by a parallel series of slips and crushings, and that about such lines of faulting and crushing there was a peculiar arrangement of the lines of hornblende crystals, not very unlike the arrangement of iron filings about the poles of a magnet, such as could not be satisfactorily explained by any theory of aqueous deposition, but pointed to a lamination by pressure.

## SECTION D—Biology

*On the Cause of the extreme Dissimilarity between the Faunas of the Red Sea and Mediterranean notwithstanding their recent connection*, by Prof. Edward Hull, LL.D., F.R.S.—The faunas of the Mediterranean and of the Red Sea are so unlike that if the beds of the two seas were upraised, and their contents examined, naturalists would probably refer them to distinct geological periods. The dissimilarity is greater than was formerly supposed. In Woodward's "Manual of the Mollusca" it is stated that seventy-four species of mollusks are common to the two seas, but Prof. Issel, of Genoa, places the number at eighteen, or about 2 per cent. Equal differences exist if we compare other great groups of life; in fact, as Prof. Haeckel well observes, the fauna of the Red Sea is related to that of the Indian Ocean, the fauna of the Mediterranean to that of the Atlantic. This extreme dissimilarity would not surprise us if it were not for the proofs of recent connection between the two seas. Evidence of old sea margins, up to about 220 feet above the present sea-level, are frequently found along the Nile and in the valleys and plains of Philistria. As many of the marine forms found in these deposits still exist, the date of the submergence may be safely referred to that of the Pliocene; but it continued to a later period, and (in the author's opinion) it to some extent remained to the time of the Pharaohs. The existing fauna probably dates back to Eocene times, when the ocean spread widely over the area in question. In the Miocene period the main outlines of land and sea as we now find them were marked out, the deposits of this age being here small and local. Under the extremely different conditions existing in the two areas, the fauna during and after the Miocene period became differentiated. The connection re-established during and after the Pliocene period was insufficient to destroy these differences, although it allowed a mingling of forms to some extent. The maximum submergence was about 220 feet; but as the summit level between the two seas is about 50 feet, the depth of water would only be about 170 feet at the maximum. Only littoral and shallow-water forms would cross in the adult state; but many forms inhabiting deeper water in the adult state might have crossed when in the free-swimming larval state. When the land again rose, and the marine straits were finally effaced, the different physical conditions of the two seas would again come into effect. The difference of temperature is now very considerable, and probably much greater during the Glacial period, especially if, as appe[ars] probable, the eastern or Levant basin of the Mediterranean w[as] separated from the others; for into this would flow the c[old] waters of the Black Sea and of Central Europe, whilst the R[ed] Sea would receive warm water, and be itself exposed t[o the] rays of a tropical sun. It would be an interesting subje[ct of] inquiry—Which of these faunas most closely resembles the the original stock?

*On the Tay Whale (Megaptera longimana) and other W[hales] recently obtained in the District*, by Prof. Struthers.—[Prof.] Struthers gave a description of the various parts of the ... of the whale. In addition to the Tay whale members [of] other whales recently obtained in the district were ex[hibited] for the purpose of comparison, and the analogy of its ... to that of other animals was specially referred to ... show its identity with the mammal. Prof. Flower joined [in the] discussion which followed, and remarked that they now ... idea at least as to the origin of the whale: it carried its ... in every part of its body. It had been thought that the ... that live upon land had been derived from progen[itors that] formerly lived in the sea, and that the mammals ... passed through an aquatic or marine stage before they ... land, but the observations of anatomy showed that th[is could not] have been the case. There was no doubt that the wha[le had] been derived from a four-footed land mammal. A[...] tions, for example, had shown that at some period of ... whales have a hairy covering, generally in the region [of the] mouth, that hairy covering being functionless and ver[y] lost even before birth. In the same way whales at ... stage of their existence are furnished with a comple[te set of] teeth, the rudiments of the teeth of the land mamm[al. The] organ of smell, although in a rudimentary state and ... species almost entirely gone, also points to the orig[in of the] whale.

*Some Points in the Anatomy of Sowerby's Whale*, b[y Prof.] Turner.—Prof. Turner remarked that *Mesoplodon* ... Sowerby's whale, of which he had dissected two specimens ... now for the first time dissected so that the viscera of ... were seen by any anatomist, or that its tail and paddle ... had been figured. The tail presents a very material ... from the customary tail in the cetacea in having the ... border smooth instead of notched. Dr. Turner called ... in detail to the intestinal and limb structure of this ... whale, showing the affinity or resemblance of the cetacea ... reptilious and the amphibious, particularly in reference ... corpus. Prof. Flower said he was glad to find tha[t Prof.] Turner had found some intention for the muscles of the ... For all that they were very rudimentary as compared w[ith the] same muscles in other animals, and he thought that h[e would] have to modify his views on this point as he had had ... regard to many other things throughout life. Prof. M... Yale College, said the intermediary bone pointed out ... Turner interested him much.

*On the Cervical Vertebræ of the Greenland Right W[hale]*, ... Prof. Struthers.—The reduced condition of the upper ... transverse processes was commented on, and the ... their different parts explained; also the completely fu[sed con]dition of the bodies of the seven vertebræ. A nearl[y ...] condition of the neck of the Pilot Whale (*Globiceph[alus]*) was demonstrated, showing in the young condition the ... epiphyses on the rudimentary vertebræ. Other specime[ns illus]trated the fibrous condition of the transverse processe[s in the] Narwhal and Beluga.

*On the Development of the Vertebræ of the Elephant*, b[y Prof.] Struthers.—The point was that in the anterior verte[bræ the] neural arches meet behind the body, covering it ... shutting it entirely out from forming any part of the ... spinal canal.

*On the Development of the Foot of the Horse*, by Prof. S[truthers.] —Dr. Struthers called attention to the fact that the ep[iphyses of] the rudimentary metacarpal and metatarsal bones ... upper or functional end, but at the reduced end ... from which only a slender ligament proceeded. ... sidered a[n inte]resting fact, one which com... of evi[...] of the horse. Th... why ... there in the ... forr ... the present day ... Th... cetac...

specimen was shown of a two-toed horse. The valuable searches of Prof. Marsh on the descent of the horse were ecially alluded to. Dr. Struthers demonstrated another fact nnected with the development of the foot of the horse:—that first phalanx, or pastern bone, has an epiphysis at both ends.

*On the Viscera of Gymnotus electricus*, by Prof. Cleland.—dependent of its electric organs, this fish has a number of narkable internal peculiarities. The curious spongy protuberces of the mucous membrane of the buccal cavity are well own to zoologists. The two swimming-bladders are remarkle for their relation to the kidneys; the anterior swimmingadder being a small structure between their anterior extremities, d the larger posterior swimming-bladder being situated altother behind their under hinder ends, while the duct of the ter ascends by the left side of the renal outlet, to be joined the duct of the other bladder before entering the gullet. The lorus also is remarkably contracted. But the most striking d altogether curious arrangements are seen on the ventral wall the abdomen. The intestine passes forward the whole length the abdominal cavity to the vent, and on its under side is a ng renal duct as wide as itself, and opening immediately hind the vent; while, opening into this duct close to its out-, are the ducts of the two ovaries, which lie one on each side, eir morphologically anterior extremities placed posteriorly, as in process of development these organs had been pulled ound from their proper sub-vertebral position until completely erted.

*The Spiracle of Fishes in its relation to the Head, as developed in the Higher Vertebrates*, by Prof. Cleland.—A very traordinary mistake can be shown to be prevalent among ibryologists, to the effect that the spiracle corresponds with e tympanum and external auditory meatus in the higher verteates. This is not the case. The spiracle is pre-oral; the mpanum is post-oral. The apparent sequence of the spiracle th the branchial clefts occurs, as Balfour described it, in the ibryo of the dog-fish; but for all that, and although it has dimentary external gills attached to its margins in the embryo, s in front of the mandibular arch and above the maxillary be. Between the middle and lateral frontal processes is the stril; between the lateral frontal process and the mandible is space into the upper part of which the eyeball projects, and m which the lachrymal duct is developed; while between the st and second visceral lobes is the external ear; and it is ghly probable that the upper part of the first branchial cleft is mologous with the clefts in front of and behind the lateral ontal process. Thus a certain amount of homology would ist between the spiracle of fishes and the lachrymal duct.

*Is the Commissural Theory of the Corpus Callosum Correct?* D. J. Hamilton, M.B., Professor of Pathological Anatomy, berdeen University.—The results recorded by the author were tained by certain special methods of preparation. They ent to prove that the corpus callosum is not an inter-hemiherical commissure, as is generally supposed, but that it is in ality the decussation of a particular system of fibres on their y downwards to join the inner and outer capsules. These res are not to be confounded with the motor and other direct res derived from the cerebral cortex, and which decussate at ne point lower down.

*The Evidence of Comparative Anatomy with regard to calisation of Function in the Cortex of the Brain*, by Alex. ll, M.A., M.B. Cambridge.—The object of the paper was show that the theory of the localisation of function in the tex of the brain must be submitted eventually to comparative atomy for proof. The key to the arrangement of the lower ts of the central nervous system is to be found, as the author l elsewhere shown, in its segmental disposition: the grey tter is disposed in clumps the cells of which bear a definite merical relation to the fibres of body nerves. The problem cussed in the present paper was the relation of the grey tter of the cortex to this lower grey matter, and therefore to body nerves. Is each region of the cortex equally in relan with all the segments of the "central grey tube"? or is cortex also divided up into areas, the superficies of each of ich varies as the amount of grey matter in the clump of the system with which it is related, and therefore as the of fibres in its associated nerve. For this investigation delimitation of the cortex are necessary, and no lable for the purpose if the fissures fail. The of the fissures is, however, established by the l brains. They are remarkably constant in their arrangement throughout animals of the same type, and in animals of different type they are very constant with regard to the order of their appearance, their progressive extension and permanent depth. The author of the paper expressed himself content, on account of the precision with which the fissures respond to the ordinary tests of homology, to place himself unconditionally in their hands, and the boundaries of the various regions of the cortex being thus marked out, it remains to devise a system of mensuration by which the superficial area of each region of the cortex may be determined for comparison with the cross-sections of the several nerves. As yet no satisfactory method of measurement has been devised, but even in the absence of exact data important results can be obtained by the observation of the brains of such animals as are conspicuous for excess or deficiency in the development of the muscular system or of one or more of the senses. As examples of such results Mr. Hill exhibited diagrams of the brains of the sheep, cat, pig, dog, and otter, enlarged from tracings of the pictures in Leuret and Gratiolet's Atlas. It was shown that, although it is impossible, as yet, to map out the brain into areas associated with the several nerves, it is quite possible to predict from the appearance of the brain the principal sensory and motor endowments of the animal to which it belonged. In the main Mr. Hill's results confirm those already obtained by Ferrier and other experimental physiologists; they seem, however, to show that they are open to correction in certain important points with regard to the areas allocated to the senses of smell, hearing, and facial sensation.

*The Action of Cold on Microphytes.*—Prof. M'Kendrick, Glasgow, gave an interesting account of the methods of trying to destroy small organisms like bacteria, not as is commonly done by heat, but by cold. It is known that by means of Coleman's cooling machine meat may be kept from putrefying for a considerable time, but in attempting to sterilise a putrescible solution by means of cold, it was found that, though in some cases putrescence was delayed, in no case were the organisms completely destroyed. Organic fluids were exposed to temperatures more than 120° below 0° F., but on thawing they were found to contain living organisms still. Thus the hope of preserving putrescible matter by means of cold—an important economical result—is, so far as investigation yet goes, destroyed. The organisms under cold seem to be in a nearly solid state, though we cannot call it a crystalline state. In a paste solution the water is crystallised under cold, the paste remaining spongy. Possibly cold may separate from these minute organisms the water they contain, and this water is again absorbed on thawing. Meat under cold becomes very friable, while yet minute fragments of it show the same microscopic constitution of muscle. It is well known that frogs have been found in blocks of ice and been revived. Frogs have been frozen at 20° F. in about half an hour. On thawing slowly the animal, in two instances, completely recovered. When it was frozen for longer than half an hour it did not recover; but, though reflex action was gone, there remained some irritability both in nerves and muscles. It was found also that certain vital functions may be arrested by cold, and thus conceivably higher organisms may be kept vitally inert for an indefinite time. Experiments were also tried on warm-blooded animals. A rabbit subjected to a temperature 100° below 0° F. recovered. No temperature lower than 73° below 0° F. has been obtained in free atmosphere. Prof. M'Kendrick gave a short sketch of the literature of the subject.

*The Action of Ozonised Air upon Micro-Organisms and Albumen in Solution*, by J. J. Coleman, F.I.C., F.C.S.—This paper described a number of experiments conducted by the author in conjunction with Prof. McKendrick, F.R.S., being supplementary to their joint investigation upon the influence of cold on microphytes. Air artificially impregnated with ozone by means of a Ruhmkorff coil, so as to contain a much larger percentage of ozone than any natural atmospheric air, was passed continuously through a 1 per cent. solution of white of egg placed in a glass flask, the inlet and outlet tubes of which were carefully plugged with cotton wool previously to commencing the experiment. It was found that a stream of air containing an amount of ozone equal in weight to the albumen in solution passed through 100 c.c. of the liquid for thirty hours, failed in producing the slightest trace of oxidation, and that the ozonised air passed through the liquid quite unaltered. During the course of the experiment and for six days following the development of micro-organisms ceased, but at the end of that time, and notwithstanding the cotton wool plugs, the liquid became slightly turbid from the presence of organisms. As dilute hydrogen peroxide is without action upon albumen, the conclusion seems inevitable that albumen is practically indestructible by any atmospheric agency without previons splitting up by micro-organisms, and further, that whilst micro-organisms cannot develop, and are probably killed in an ozonised atmosphere, these spores are not easily destroyed by its agency. These results confirm the surmise of the late Dr. Angus Smith that putrefaction is a necessary preliminary to oxidation in all cases of *natural* river purification. Prof. Burdon Sanderson, Dr. W. B. Carpenter and Capt. Douglass Galton all commented upon the practical value and interest of this paper, Capt. Douglas Galton observing that the sooner organic matter of sewage is got on to land the better.

*The Use of Graphic Representations of Life-Histories in the Teaching of Botany*, by Prof. Bower.—This was a paper referring to a series of diagrams prepared by the author to bring in review the chief facts in the life-history of the moss, fern, equisetum, *Selaginella*, a conifer, and an angiosperm. Prof. Bower pointed out that these diagrams could be extended to include lower forms, and that they are only intended for use *after* the student has mastered the facts in detail in the laboratory. Having described the diagrams and referred to some interesting processes of vegetative reproduction in the mosses and ferns, the author then proposed for discussion a series of questions as to the advisability of employing such diagrams, or of extending their use. The discussion which followed was taken part in by Sir J. Lubbock, Profs. Bailey Balfour (Oxford), M'Nab (Dublin), Trail (Aberdeen), Mr. Marshall Ward (Owens College), and others, and several suggestions were proposed for rendering Prof. Bower's graphic representations still more graphic.

*A New Theory of the Sense of Taste*, by Prof. J. Berry Haycraft.—The author showed that "quality" in this sense depends upon the nature of the atoms found in the sapid molecule. A study of the periodic law demonstrates that similar tastes are produced by combinations which contain elements such as lithium, sodium, potassium, which show a periodic recurrence of ordinary physical properties. Among the carbon compounds those which produce similar tastes are found to contain a common "group" of elements. Thus organic acids contain the group CO.OH, the sweet substances $CH_2$.OH. There is no relation between quality of sensation and gross molecular weight, except that substances of either very small or very great molecular weight are not tasted at all.

*On the Hybridisation of Salmonidæ at Howietoun*, by Francis Day.—During the last eleven years Sir J. R. Gibson-Maitland, at Howietoun, near Stirling, has devoted much attention to this subject, and gone to great expense in order to efficiently carry out the many experiments he has instituted, while he has likewise afforded the author facilities for personally watching many of them, and furnished him with data as well as with specimens. When we consider that the ova of teleostean or bony fishes have, as a rule, to be fertilised by the milk of the males diffused in the surrounding water, it is not difficult to believe that this fluid from the male of one genus might come into contact with the eggs from fish of another species, genus, or even family, and a hybrid offspring be thus occasioned. But the size of the micropyle of the ovum and that of the spermatozooid of the milt must be of conforming capacities, or fertilisation would be a physical impossibility. It would appear from the experiments made that the following conclusions may, with more or less probability, be drawn:—(1) Salmon and trout, trout and char, and different species of char, may interbreed and give rise to fertile hybrids. (2) Hybrids raised from Lochleven trout eggs fertilised by salmon milt, breed in their fourth year, similar to young female salmon kept under the same conditions. (3) The anadromous instinct is not lost in these trout and salmon hybrids. (4) Judging from the period of breeding in the foregoing hybrids, the male element is prepotent. (5) In hybrids raised from Lochleven trout eggs fertilised by the milt of the American char, the male element would appear to be prepotent, if we judge simply by the colour of the offspring. (6) In hybrids raised from American char eggs fertilised by the milt of the Lochleven trout, the female element would appear to be prepotent, if we judge simply by the colour of the offspring. (7) In hybrids raised from American char eggs fertilised by the milt of the British char, the male element would appear to be prepotent, if we may judge simply by the colour of the offspring. (8) In all instances of hybridisation between different species, as between salmon and trout, or trout and char, numerous instances of malformation and great mortality occur among the [illegible] much less when two forms of char are intercrossed. [illegible] crossing hybrids both the eggs and milt were found [illegible] but the malformations and mortality very great. [illegible] however, at Howietoun are not yet of sufficient age [illegible] safe deductions on this head. (10) The age of the [illegible] cises great influence on the vitality of the offspring. [illegible] very young, we may expect a large percentage of [illegible] as well as dropsy and other diseases of the offspring.

*Chinese Insect White Wax*, by A. Hosie.—The [illegible] with a reference to the European and Chinese [illegible] mention Chinese insect white wax, and then proce[illegible] that, although the province of Ssu-chuan, in West[illegible] where he has been stationed for the last three years, [illegible] wax-insect and wax-producing country in the [illegible] and wax are found in other provinces. Mr. Hosie [illegible] upon by the Foreign Office to collect for Sir J[illegible] specimens connected with, and all possible informa[illegible] subject of this industry, and he states that the present [illegible] revision, with additions, of a Report already [illegible] Parliamentary paper in February last. He describe[illegible] producing country, the tree on which the insects are [illegible] the insects themselves, and their transit from the valle[illegible] chang, their breeding-ground, in the west of Ssu-[illegible] the mountains to Chia-ting Fu, the habitat of the [illegible] This tree is then described, and details are given [illegible] ment of the insects, their suspension on the trees, the [illegible] of the wax, and of a parasite on the insects. The [illegible] removing the wax from the branches of the tree and [illegible] it for market is then explained. The author then [illegible] result of an examination of the insects after the wax [illegible] fully deposited, finally passing to the annual quant[illegible] white wax produced, its value, and uses.

*On the Size of the Brain in Extinct Animals*, by [illegible] Marsh.—Prof. Marsh, of Yale College, said that [illegible] years he had directed his attention to the subject of [illegible] the brain in extinct animals. In every instance he [illegible] the mammals from the lower Tertiary had very small br[illegible] carried out his investigation into the upper Tertiary, [illegible] that the brain was much larger in the pliocene [illegible] miocene. All the tertiary mammals had small br[illegible] was a gradual increase in the size of the brain during [illegible] and this increase in the size was generally in the [illegible] sphere or higher portions of the brain. In some [illegible] convolution of the brain had gradually become more [illegible] In some the cerebellum and the olfactory lobes had [illegible] ished in size. There was now evidence that the same [illegible] law of brain growth holds good for birds and reptiles [illegible] Jurassic period to the present time. The brain of [illegible] belonging to a vigorous race fitted for a long survival [illegible] than the average brain of that period in the same grou[illegible] brain of a mammal of a declining race was smaller [illegible] average brain of its contemporaries of the same gr[illegible] small animals now existing had proportionally larger [illegible] the larger animals, and young animals had proportiona[illegible] brains than adult animals. They found some [illegible] examples which threw light on this question. For insta[illegible] the Eocene they had an animal, the oldest known [illegible] the rhinoceros, and it had an exceptionally large brain. [illegible] all the facts together it seemed as though this brain grow[illegible] an important element in the survival of animals. If the [illegible] became large and unwieldly with a small brain, it [illegible] liable to suffer from any change of climate. In other [illegible] early time the big brain conquered as it is the big brai[illegible] conquers in civilisation to-day. Prof. Flower said it was [illegible] factory to find a case where the facts worked out coincide[illegible] previously-formed theories, because that was not alw[illegible] case, and sometimes the facts or the theories had to go [illegible] wall. In this case they had no such difficulty; and they [illegible] thank the American Government for the way in whi[illegible] taken up Prof. Marsh's work and were disseminating it.

*On the Syst[illegible]ition of the Chamæleon [illegible] Affinities wit[illegible]* by D'Arcy W. Thomps[illegible] —The auth[illegible] anatomical differe[illegible] separate th[illegible] Lacertilia ar[illegible] with marke[illegible] group Sauro[illegible] that of (*e.g.*) [illegible] Lacertilia in the [illegible] absence of coraco[illegible] vicle. Equally marked affinities with the Dinosauria may be ced in the carpus and tarsus, sternum, pelvis, and skull. While ilarly the comparatively large size of the cerebellum, the sence of a urinary bladder, and the presence of pulmonary erticula or rudimentary air-sacs, are all foreshadowings of ithic structure.

*The Origin of the Fishes of the Sea of Galilee*, by Prof. Hull.— the abundant fishes of the Sea of Tiberias nearly one-half of species are peculiar to the lake and its tributaries, while of rest only one, *Blennius lupulus*, belongs to the ordinary editerranean fauna; two others are found in the Nile; seven ier species occur in the rivers of South-Western Asia; and ten ore are found in other parts of Syria. Tristram considered it this assemblage pointed to a close affinity of the fauna of Jordanic basin with that of the rivers of tropical Africa; but iat most struck the observer was perhaps the speciality of the ecies to Jordanic waters, sixteen out of a total of thirty-six ecies being peculiar. Assuming that the forms which are mmon to Jordanic and other waters had been distributed in a anner similar to that by which they had to account for the stribution of lacustrine forms in other parts of the world, they d yet to account for the presence of the forms which were ecial and peculiar. After referring to the formation of the rdanic basin, Prof. Hull argued that by the subsidence of the oor of the sea along the line of the Jordan valley an inland ke was formed whose waters were first derived from those of e ocean itself, in which were enclosed the fishes, mollusks, d other forms which inhabited these waters themselves. The w of "descent with modification" would come into operation, d they might suppose that throughout the Miocene and Plio ne periods the process of modification in form, colour, and bit gradually proceeded. The fittest forms would survive, d differentiation between those of the outer and inner seas ould result in an almost entire specific change. Prof. Hull o read a paper on the cause of the extreme dissimilarity etween the faunas of the Red Sea and Mediterranean, notwith anding their recent connection.

*The St. Andrews Marine Laboratory.*—Prof. M'Intosh stated iefly the structure and arrangement of the marine laboratory St. Andrews, and made some general remarks on the work one during the last nine months there. A great many of our od fishes, he said, were carefully examined in regard to the evelopment of the eggs and the growth of the young fishes. bout twenty species were examined in this way. They expe enced some difficulty with some of the forms, on account of ieir voracity, particularly with the cod. They found that a cod f five inches long would swallow a cod of three inches, and if could not get it all down at once, it would keep it in its throat ll the head part was digested, and then draw in the tail. Iollusca were studied chiefly in connection with the develop ient of the mussel, but he might say that very hazy notions ere held in regard to it. Some larger forms were also ex mined, including porpoises and sharks. One porpoise was xtremely interesting. He had noticed it for some time in the ay, and that its motions were very peculiar. He could not iake out what it was doing there so constantly in shallow water. ut some days afterwards a large female was caught in the almon nets, and they found that it was a female giving milk. ts milk was of a most interesting kind, and formed the subject f examination and analysis by Prof. Purdy. It was as dense s cream, and of a deep yellow colour.

*On a Chemical Difference between Living and Dead Protoplasm*, by Dr. Oscar Loew, of Munich.—Protoplasm, it was ound, contains certain aldehyd groups, which account for the xtreme mobility and readiness of change in living protoplasm. hese aldehyd groups can be reduced by very dilute alkaline olutions of silver salts. *Spirogyra*, one of the lower *algæ*, acts n this solution in a peculiar way. Living protoplasm reduces the alt, while dead protoplasm does not. The specific gravity of the rotoplasm of *Spirogyra* was increased, and was found to contain ilver deposited in its interior. Argyria, or the effect of nitrate silver on the human subject in certain diseases, was found in ... Thus was shown a specific chemical difference ... and dead protoplasm Ordinary poisons, such ... strychnine, have no such striking effect on ... poison to all protoplasm is hydroxylamyl. ... said that this investigation had more ... first appear, for it had arisen out of ... Pflüger. Pflüger concluded that ... in the transition from living to dead protoplasm, and Dr. Loew took up the question as to what exactly this change was. His investigations are an important step in deciding this most important question. Prof. Stirling said this gave us a new test for living protoplasm. The chief thing to settle was what exactly causes reduction of the silver.

*Digestion of Proteids in Plants*, by Sidney Martin, M.D. (Lond.), B.Sc., M.R.C.P.—Of proteolytic ferments occurring in plants two kinds have been described—one acting like animal pepsin, and occurring in carnivorous plants, in the seeds of vetches, hemp, flax, barley, and malt, and the fruit of the fig, *Ficus cerica*; the other acting like animal trypsin (pancreatin) and occurring in the juice of the green fruit of *Carica papaya* (the papaw tree). The use of these ferments in the plant economy has only been surmised by testing their action on animal proteid, from which they form peptones. It is a question whether they form peptones from the proteid occurring in the individual, and from two considerations. It is doubtful whether a true peptone exists in plants—by which I mean a proteid soluble in water, and not precipitated by boiling, nitric acid, or acetic acid and potassic ferrocyanide. Vines (*Journal of Physiology*, vol. iii.) concludes that the body called vegetable peptone is hemialbumose (Meissner's *a*-peptone). It is also evident that the action of these ferments on the proteids will be slow in comparison to the action of animal proteolytic ferments; thus there might appear the proteids intermediate between albumen and peptone, which Kuhne and Chittenden call *albumoses* (*Zeitschrift f. Biologie*, Bd. xx.). These questions I attempted to settle in the case of the papaw juice. I first of all extracted the proteids, which consisted of a *globulin*, corresponding to animal paraglobulin; two albumoses, which I propose to call *α*- and *β-phytalbumose*. The *β* form is precipitated; the *α* form is not thrown down by boiling; a vegetable *albumen* corresponding to egg-albumen. The effect of pure papain (the proteolytic ferment of the papaw juice) was tested on each of these bodies, but from none of them was a true peptone formed; only a body corresponding to Meissner's *b*-peptone. The very slow proteolysis explains the limitation of the formation of the final products of proteid change. Leucin and tyroin were formed. Full details of methods and results will be found in the forthcoming *Journal of Physiology*, September 14, 1885.

*On the Application of the Anatomical Method to the Determination of the Materials of the Linnean and old Herbaria*, by Prof. L. Radlkofer.—Prof. Radlkofer spoke generally of the anatomical method of botanical study, and dwelt on the results that had already been accomplished by it. With the aid of the anatomical system he advocated an extensive review of the herbaria of the country with reference to the writings of their former possessors. These herbaria should henceforth not merely be preserved; there should be the diffusion of new light on their contents so as to become useful to every one in a scientific sense, even to those who are unable to look through them. At some length he demonstrated the value of anatomical characters in systematic botany, and concluded with an appeal to all English botanists to direct their attention and their influence to the accomplishment of the work. In the accomplishment of this the British Association might, perhaps, give substantial assistance.

*Notes on Experiments as to the Formation of Starch in Plants under the Influence of the Electric Light*, by Mr. M. Ward, of the Owens College, Manchester.—The experiments, Mr. Ward said, were made not so much to determine a point already determined generally—that plants can be grown under the influence of the electric light—as to discover how far the electric light can be used for teaching purposes and investigations in the laboratory so to speak as an artificial sunlight. It would obviously be of enormous advantage to the vegetable physiologist if experiments could be easily performed under the influence of electric light. He explained the experiments he had made in the laboratories at the Owens College, Manchester, and at the residence of Mr. W. Crossley, of Bowden (who kindly placed a powerful arc lamp at his disposal), on this interesting subject, and described the means that had been employed in devising and conducting the experiments. Under a powerful arc light the results had been fruitful; but small clusters of Swan lamps had yielded no satisfactory results, at any rate at low temperatures. The subject requires still further examination, however, and Mr. Marshall Ward intimated that he intended to carry on the experiments, so that at a future date he might be able to convey more detailed information than could be given in a paper of a preliminary character. The plants employed were hyacinth potato, Algæ,

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[illegible] ; nor is it chimerical to conceive a
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[illegible] the example of Nordenskjöld in Green-
[illegible] interesting matter requires investigation, from
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Moreover, another magnetic survey is most desirable
[illegible] termine what secular change has been made in the
terrestrial magnetism after an interval of forty years
[illegible] taken by Ross. In fact, there exists a wide
[illegible] investigation in the unknown South Polar Sea.
[illegible] will, I trust, be the prelude for others to follow in
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[illegible] *the Reian Mœris, and the Province,* [illegible] *to the Patriarch Joseph*, by Cope [illegible] The Berlin Geographical So- [illegible] for May, 1885 (No. 116), [illegible] Fayoum to Behnesa, and [illegible] by Dr. Ascherson [illegible] graphical observa- [illegible] much of the [illegible] the Quasr [illegible] author [illegible] that [illegible] feet [illegible] of this paper, established a depth of – 175 to – 180 English feet. The greatest depth is probably under the western cliffs [illegible] th of the Haram Medhûret el-Berl. No previous explorer [illegible] nceived it possible that this might have been a lake within [illegible]. The level of the ruins, as determined by Caill- [illegible] that the ancient station of Ptolemais might have [illegible] represented in the text and maps of Claudius Ptolemy, [illegible] on-shaped lake about 35 miles long and 15 wide, with a [illegible] mum depth of 300 feet, fed by a canal, partly subterranean, [illegible] Behnesa, as well as by a branch of the present Bahr Jûsuf communicating with it through the Fayoum. The lower plain of the Fayoum had been, at that time, fully redeemed, and the present Lake of the Horn reduced to such insignificant dimensions as to be unnoticed. The restoration of the Reian basin of Lake Mœris and the drainage by evaporation of the Birket el-Querûn would be a repetition in modern times of the best results reached in the Greco-Roman period, perhaps 3000 years after the first effort to utilise these two unique basins for storage and drainage.

*On Batho-hypsographical Maps, with Special Reference to a Combination of the Ordnance and Admiralty Surveys*, by E. G. Ravenstein.—The batho-hypsographical map, which exhibits the vertical configuration of the solid surface of the earth, above as well as below the ocean levels, is a product of modern times. It was Gerard Mercator who first inserted soundings upon a chart in 1585, but nearly two centuries passed away before Cruquins, in 1728, introduced the fathom-lines with which we are all familiar. Buache, and after him Ducarla, first suggested the introduction of contours upon maps, and their idea was realised in 1791 by Dupain-Triel on a map of France. The combination of these two descriptions of contoured maps we owe to modern German geographers, and more especially to Berghaus, Von Sydow, and Ziegler. Cartographers, in effecting this combination, had hitherto quite lost sight of the fact that the heights on maps are referred to high or mean water, whilst the depths on charts represent soundings reduced to low water. This rough method gave satisfactory results when dealing with maps on a small scale, but a more rigid method would have to be applied when it was desired to combine accurate surveys like those made by the Ordnance and Admiralty Departments. The so-called mean level of the sea was not a suitable datum level, and it would be necessary to carry on tidal and other scientific observations on a far more comprehensive plan than had been done hitherto if a really satisfactory batho-hypsographical map of the British Islands were to become attainable. These various supplementary surveys, tidal observations, &c., it was to be hoped, would expand into a comprehensive scientific survey of the British seas.

*What has been done for the Geography of Scotland, and what remains to be done*, by H. A. Webster.—After remarking on the unsatisfactory state of the Ordnance Maps, Mr. Webster said that in regard to the depth of our lakes and rivers—and the submerged portion of a valley is geographically as interesting as the sub-aerial portion—absolutely no data are supplied by the Ordnance Survey. Nor, with a few individual exceptions, do they exist in an accurate and trustworthy form anywhere else. It was an open secret that, when this omission was pointed out to the Government by the Royal Societies of London and Edinburgh, the Lords of the Treasury refused, and again refused, to authorise a bathymetrie lake and river survey being carried out, either by the officers of the Ordnance Survey or by those of the Hydrographic Department. Such a refusal could not be permanently accepted. It was to be hoped that when the Government was next urged to move in the matter they would be asked for more, and not for less. We required not only a hydrographic survey done once and for all (though that was worth the doing); we required a systematic registration of hydrographic facts throughout the country, in order that the [illegible] *régime* both of lakes and rivers may be known in detail with scientific precision. The ignorant niggardliness of the [illegible] Government was in striking contrast to the conduct of [illegible] some foreign countries. In Switzerland, for instance, [illegible] regular system of inland hydrographic observations, [illegible] *régime* of all the principal rivers was annually [illegible] red easily intelligible by a series of graphic [illegible] to a Swiss river we could tell the volume [illegible] at several important points, and could [illegible], for instance, with those of any year [illegible] every one knew what a vast body of [illegible] tions been accumulating about

*Faba, Phaseolus, Dicentra*, and the vine, and some interesting remarks on methods, &c., were made in the discussion which followed.

*On the Coloration of the Anterior Segments of the Maldanidæ*, by Allen Harker, F.L.S., Professor of Natural History, Royal Agricultural College, Cirencester.—The author, while studying the circulation and respiration of annelids at the zoological station at Naples, had been specially interested in the Maldanidæ, from their partially tubiculous habit and the brilliant coloration of their anterior segments. The bands of colour usually ornament the anterior segments, beginning with the second or third, and continuing to the ninth; but the distribution of the coloured bands differs widely in the different species. The colour in living or freshly-killed specimens is of a rich rose madder colour, shading off in each segment to a brighter rose-pink hue. Quatrefages attributed a physiological value to these coloured bands, describing them as being connected with the respiratory function. In connection with the whole subject of cutaneous respiration in annelids, it appeared important to settle this question, and the author made sections of the anterior segments in the Maldanidæ, and finds the colour to be due to a special pigment, whose behaviour under various reagents he described. On the other hand the author has studied the blood-vessels and their distribution in the living chætopod, and is satisfied that it extends equally in those portions of the cuticle which are uncoloured as in those which are. The coloured bands do not appear, therefore, to be in any way connected with the function of respiration.

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## SECTION E—Geography

*The Indian Forest School*, by Major F. Bailey, F.R.G.S., Royal Engineers, Director of the School.—It is only within the last twenty-five years that a special State department has administered the Indian forests. The staff was at first composed of men who had received no professional education, but they were able to do all that was then needed, and they accomplished work of great value. But as a result of their work the State became possessed of large forest areas, from which a permanent supply of produce had to be secured, and which had therefore to be managed systematically. At this time nothing was known of systematic forestry in England or in India, and an arrangement was made in 1866 under which candidates for the Indian Forest Service were trained on the Continent. The arrangement with the French Government is still in force, but it has now been decided to undertake the instruction in England. Great progress has been made in Indian forestry, which is mainly due to the professionally-trained men with whom the Forest Department has been recruited, but up to 1869 nothing had been done towards the education of the subordinate ranks. As work requiring professional skill became necessary over large areas, it was found that the "divisions" must be broken up into a number of smaller executive charges under natives of the country, and that they must receive a professional education. In 1869 Mr. Brandis made proposals to organise the subordinate grades and to train men at the Civil Engineering Colleges, and several other attempts were made in the same direction, but without marked success. In 1878 Mr. Brandis proposed to establish a Central Forest School, and his proposals were accepted by Government. The chief object of the School was then to prepare natives of India for the executive charge of forest ranges, and to qualify them for promotion to the superior staff, but it was hoped that the school might ultimately be used to train candidates for the controlling branch. The chief forest officers of provinces were to select candidates and send them to be trained at the School. None but natives of India were to be admitted. A number of forests near Dehra Dun were grouped together as a training ground and placed under a separate conservator, who was also appointed director of the school. A board of inspection was appointed. The first theoretical course was held in 1881, and they have been held every year since then. The present system is that the candidates, who must be in robust health, are selected by conservators of the forest or by the director of the school. They must serve in the forests for at least twelve months before entering the School. Candidates for the ranger's certificate must have passed the entrance examination of an Indian University on the English side; candidates for the forester's certificate pass a lower examination. The course of training for these two classes extends over eighteen and twelve months respectively. Men who gain the certificates return to their provinces, and are employed there. Th[e] of instruction for the ranger's class embraces vegetable [...]logy, the elements of physics and chemistry, mathemati[cs] making and building, surveying, sylviculture, working [...] forest utilisation, forest botany, the elements of minera[...] geology, forest law, and the elements of forest zoolog[y] course for foresters is much more simple. The pre[...] manuals is in progress, and a library, museum, chemi[...] tory, observatory, and forest garden have been establi[shed] period of probation in the forest before entry into th[e] has a twofold object: firstly, to enable the theoretical be understood; secondly, to eliminate men who are [...] a forest life before time and money have been spen[t] training. As a rule, the students are *employés* of th[e] Department, and they draw their salaries and main[tain them]selves while at the School. No instruction fees are cha[rged] would not at present be possible to get condidates wh[...] tenance and education are entirely paid for by the[...] Nine men who have left the School have appointmen[ts] 125*l.* to 200*l.* a year, and this ought to draw eligible ca[ndidates] Conservators of forests say that the men trained at th[e] are markedly superior to their untrained comrades [...] of reserved forests has largely increased of late, and the [...] of the students are very good. During the session there were forty-six students of all classes at the School, eight were from Madras, and seven from native States, [...] of which have been induced by the establishment of t[he] to take measures for the protection of their forests. T[he] has now been made an imperial institution, and this [...] advantage in every way. The expenses of the School are said to have been 1911*l.*

*On Journeyings in South-Western China*, by A. H[osie].—[In] the autumn of 1881 Mr. Hosie was appointed Her M[ajesty's] Agent in Western China, and reached Ch'ung-ch'in[g] [...] province of Ssŭ-ch'uan, in January, 1882. From th[...] made three journeys in South-Western China. In the [...] 1882 he proceeded through Southern Ssŭ-ch'uan and [...] Kuei-chou, the Chinese "Switzerland," to Kuei-yang [...] capital of the latter province, whence he journeyed we[st] [...] the footsteps of Margary to the capital of Yunnan [...] Yünnan Fu he struck north-east through Northern [...] following for days here and there the routes of Garnier [...] Grosvenor Mission. At last he descended the Nan-kua[ng] and reached the right bank of the Great River, the [...] of the Upper Zangtsze, at a point below Hsü-chou Fu [...] portant city at the junction of the Min River and the [...] Chiang, or River of Golden Sand. Here he took [...] descended the Great River to Ch'ung-ch'ing, his starting [...] In February, 1883, Mr. Hosie again left Ch'ung-ch'in[g] proceeded north-west to Ch'êng-tu, the capital of the [...] of Ssŭ-ch'uan, by way of the brine and petroleum [...] Tzŭ-liu-ching. From Ch'êng-tu he journeyed west an[d] [...] west through the country of the Lolos, skirting the [...] boundary of Independent Lolodom. From Ning-yuan [...] called Chien-ch'ang, and lying in a valley famous, amon[g] things, as the habitat of the white-wax insect, he passe[d] west through the mountainous Cain-du of Marco P[olo] [...] habited in great part by Mantzŭ tribes, and struck the [...] of the Chin-sha Chiang two months after leaving Ch'ung[...] From this point Ta-li Fu, in Western Yunnan, wa[s] reached. From Ta-li Fu Mr. Hosie jurneyed east[...] Yunnan Fu, which he had visited the year before, an[d] struck north-east through Western Kuei-chou to the Y[...] River, which he descended to the Great River. Lu Ch[ou] [...] important city at the junction of this river with the T'o [...] was soon reached, and the Great River was again descen[ded to] Ch'ung-ch'ing. This journey occupied four months. I[n] 1884, Mr. Hosie again left Ch'ung-ch'ing, and from H[...] a three days' journey to the north of that city, he stru[ck] [...]ward through a beautifully cultivated and fertile country [...] ting Fu, on the right bank of the Min at its junction w[ith the] T'ung River. Chia-ting is famous as the great centre [...] culture in Ssŭ-ch'uan, and as the chief insect wax-pr[oducing] country in the Empire. A day's journey west of Chia[-ting] [...] the famous Mount O-mei, rising 11,100 feet above the [...] the sea. This mountain, which is sacred to the w[orship of] Buddha, Mr. Hosie ascended in company with crowds [of pil]grims. He then proceeded south, skirting the eastern b[order] of Independent Lolodom, to the River of Golden S[and], [the] left bank of which was struck at the town of Man-i-ssŭ [...]

orty and fifty miles above P'ing-shan Hsien—the highest point eached by the Upper Yangtsze Expedition in 1861. From Man i-ssŭ Mr. Hosie descended the Chin-sha Chiang and the Great River to Ch'ung-ch'ing.

*Antarctic Discovery*, by Admiral Sir Erasmus Ommanney, C.B., F.R.S.—The object of this paper is to draw attention to the neglect of the Antarctic region as a field for exploration. The author gives a summary of the work which has lready been done by Cork, Bellingshausen, Weddell, Biscoe, Balleny, Wilkes, Dumont d'Urville, James Ross, and Nares (in he *Challenger*). The author refers to a paper by Dr. Neumayer on the subject, the substance of which was reproduced in NATURE (vol. vii. p. 21). The author concludes as follows:—I have thus laid before you but a very imperfect description of hese voyages; to give the details of the scientific results would occupy a separate paper. But I have endeavoured to demontrate how large a field remains open for discovery. I think, rom all we now know, we may infer that the South Pole is apped by an eternal glacier; and, from the nature of the oundings obtained by Ross, it would appear that the great icewall along which the ships navigated was the termination of the lacier—the source from which the inexhaustible supply of icebergs and ice-islands are launched into the Southern Ocean, many of which drift to the low latitude of 42°. The fact of inding the volcanoes of equal proportions to Etna or Mont Blanc creates a zest for further research regarding that awful egion on which neither man nor quadruped ever existed. No man has ever wintered in the Antarctic zone. The great desideratum now before us requires that an expedition should pass a winter there, in order to compare the conditions and phenomena with our Arctic knowledge. The observations and data to be collected there throughout one year could not fail to produce matter of the deepest importance to all branches of cience. I believe that such an achievement can be accomplished n these days with ships properly designed and fitted with the means of steam propulsion; nor is it chimerical to conceive a sledge party travelling over the glacier of Victoria Land towards he South Pole, after the example of Nordenskjold in Greenand. Another interesting matter requires investigation, from he fact that all the thermometers supplied for deep-sea temperatures to Ross were faulty in construction, as they were then not adapted to register accurately beneath the weighty oceanic pressure. Moreover, another magnetic survey is most desirable n order to determine what secular change has been made in the elements of terrestrial magnetism after an interval of forty years and more, when taken by Ross. In fact, there exists a wide ield open for investigation in the unknown South Polar Sea. This paper will, I trust, be the prelude for others to follow in arousing geographers and this powerful Association in promoting urther research by despatching another South Polar expedition, having for its object to secure a wintering station. No other nation is so capable of providing and carrying it out. Even in he Australian colonies there exists the spirit and the means for uch a noble enterprise.

*Projected Restoration of the Reian Mœris, and the Province, Lake, and Canals ascribed to the Patriarch Joseph*, by Cope Whitehouse, M.A., F.A.G.S.—The Berlin Geographical Society has published, in its *Zeitschrift* for May, 1885 (No. 116), he latest map of Egypt, from the Fayoum to Behnesa, and rom the Nile to the Little Oasis. The text by Dr. Ascherson gives credit for a considerable area to the topographical observations presented to this society at Montreal. So much of the Reian basin as lies between the Quasr Qerûn and the Quasr Reian has not been visited by any European except the author of this paper (1882, 1883). It is now an accepted fact that here is a depression south of the Fayoum, not less than 150 feet below the level of the Mediterranean, with a superficial area at he level of high Nile of several hundred square miles. It is rregular in shape, curving like a horn from a point near Behnesa o the ridge which separates it from the Fayoum. In the southern part are two, and perhaps three, patches of vegetation, wild palm-trees, and ruins of Roman and early Christian date. This part was visited by Belzoni, May 22, 1819; Caillaud, November 24, 1819; Pacho and Muller, 1823–24; Sir G. Wilkinson, 1825; Mason Bey, 1870; and Ascherson, March 27, 1876. Dr. Ascherson determined by aneroid observations that his camp was 29 metres below the sea. Caillaud found ruins about + 38m., or about the level of high Nile in the valley on the ame latitude. The aneroid, theodolite, and other observations of March 6 and April 4, 1882, and April, 1883, by the author of this paper, established a depth of – 175 to – 180 English feet. The greatest depth is probably under the western cliffs south of the Haram Medhûret el-Berl. No previous explorer had conceived it possible that this might have been a lake within historic times. The level of the ruins, as determined by Caillaud, shows that the ancient station of Ptolemais might have been, as represented in the text and maps of Claudius Ptolemy, on a horn-shaped lake about 35 miles long and 15 wide, with a maximum depth of 300 feet, fed by a canal, partly subterranean, from Behnesa, as well as by a branch of the present Bahr Jûsuf communicating with it through the Fayoum. The lower plain of the Fayoum had been, at that time, fully redeemed, and the present Lake of the Horn reduced to such insignificant dimensions as to be unnoticed. The restoration of the Reian basin of Lake Mœris and the drainage by evaporation of the Birket el-Querûn would be a repetition in modern times of the best results reached in the Greco-Roman period, perhaps 3000 years after the first effort to utilise these two unique basins for storage and drainage.

*On Batho-hypsographical Maps, with Special Reference to a Combination of the Ordnance and Admiralty Surveys*, by E. G. Ravenstein.—The batho-hypsographical map, which exhibits the vertical configuration of the solid surface of the earth, above as well as below the ocean levels, is a product of modern times. It was Gerard Mercator who first inserted soundings upon a chart in 1585, but nearly two centuries passed away before Cruquins, in 1728, introduced the fathom-lines with which we are all familiar. Buache, and after him Ducarla, first suggested the introduction of contours upon maps, and their idea was realised in 1791 by Dupain-Triel on a map of France. The combination of these two descriptions of contoured maps we owe to modern German geographers, and more especially to Berghans, Von Sydow, and Ziegler. Cartographers, in effecting this combination, had hitherto quite lost sight of the fact that the heights on maps are referred to high or mean water, whilst the depths on charts represent soundings reduced to low water. This rough method gave satisfactory results when dealing with maps on a small scale, but a more rigid method would have to be applied when it was desired to combine accurate surveys like those made by the Ordnance and Admiralty Departments. The so-called mean level of the sea was not a suitable datum level, and it would be necessary to carry on tidal and other scientific observations on a far more comprehensive plan than had been done hitherto if a really satisfactory batho-hypsographical map of the British Islands were to become attainable. These various supplementary surveys, tidal observations, &c., it was to be hoped, would expand into a comprehensive scientific survey of the British seas.

*What has been done for the Geography of Scotland, and what remains to be done*, by H. A. Webster.—After remarking on the unsatisfactory state of the Ordnance Maps, Mr. Webster said that in regard to the depth of our lakes and rivers—and the submerged portion of a valley is geographically as interesting as the sub-aërial portion—absolutely no data are supplied by the Ordnance Survey. Nor, with a few individual exceptions, do they exist in an accurate and trustworthy form anywhere else. It was an open secret that, when this omission was pointed out to the Government by the Royal Societies of London and Edinburgh, the Lords of the Treasury refused, and again refused, to authorise a bathymetric lake and river survey being carried out, either by the officers of the Ordnance Survey or by those of the Hydrographic Department. Such a refusal could not be permanently accepted. It was to be hoped that when the Government was next urged to move in the matter they would be asked for more, and not for less. We required not only a hydrographic survey done once and for all (though that was worth the doing); we required a systematic registration of hydrographic facts throughout the country, in order that the true *régime* both of lakes and rivers may be known in detail and with scientific precision. The ignorant niggardliness of the British Government was in striking contrast to the conduct of those of some foreign countries. In Switzerland, for instance, there was a regular system of inland hydrographic observations, by which the *régime* of all the principal rivers was annually recorded and rendered easily intelligible by a series of graphic bulletins. In regard to a Swiss river we could tell the volume at any period of the year at several important points, and could compare the facts of 1884, for instance, with those of any year in the last two decades. Every one knew what a vast body of interesting data had for generations been accumulating about such rivers as the Po and the Rhone, and many had no doubt heard of the system of hydrographic stations recently established by the Italian Government in the basin of the Tiber. Why should we not endeavour to learn something definite and precise about the character of our own rivers? The investigation was only the natural complement, on the one hand, of the physical structure of the country, and, on the other hand, of its meteorology. Our Scottish Meteorological Society had now succeeded in establishing meteorological stations throughout the country; let hydrographic stations bear them company along our principal rivers. Rainfall and river discharge were mutually illustrative.

*On Overland Expeditions to the Arctic Coast of America*, by John Rae, M.D., F.R.S.—The following table shows the approximate amount of geographical work done by the expeditions under—

| | | | G. M. | | G. M. | G. M. |
|---|---|---|---|---|---|---|
| 1821. | Franklin & Richardson ... | on foot ... | 35 | in canoes | 415 | 450 |
| [1] 1826. | " " ... | " ... | 90 | in boats | 955 | 1045 |
| | | | | Total ... | ... | 1495 |
| 1834. | Back ... ... ... ... ... | in boat / on river ... | 120 | in boat / on coast | 105 | 225 |
| 1837 / [2] 1838. / 1839. | Dease & Simpson (H. B. Co.) | on foot ... | 95 | in boats | 722 | 817 |
| 1847. / [3] 1851. / 1853-4. | Rae (H. B. Co.) ... ... | sledging / on foot ... | 1123 | in boats | 369 | 1492 |
| | | | | Grand total ... | | 4029 |

*A Word or Two on the Best and Safest Route by which to attain a High Northern Latitude*, by John Rae, M.D., LL.D., F.R.S., F.R.G.S., &c.—The plan proposed is that the route by the west shore of Spitzbergen should be taken by one, or perhaps two, steamers similar to the fine vessels used in sealing and whaling at the present time. That after forcing the ice "pack" at the north-west end of Spitzbergen, a north-east course towards Franz-Josef Land should be followed. That a depot of coals should be placed at a convenient harbour in North Spitzbergen. Extracts are given from Parry's "Narrative," 1827, pp. 101 and 148, showing how open and small the ice was in latitude 82° 45′ N. The southern drift of the ice that so obstructed the advance of Parry's boats will be no great impediment to a powerful steamer, whilst if she gets helplessly fixed in the pack she will drift homewards with it. No well equipped and powerful steamer has tried this route.

## *JAPANESE TATTOOING*

THE last number (Heft 32, May, 1885) of the *Mittheilungen der deutschen Gesellschaft für Natur- und Völkerkunde Ostasiens* is almost wholly occupied by a paper of a most exhaustive character by Dr. Baelz, a physician in the service of the Japanese Government, on the physical qualities of the Japanese. A previous paper by the same writer gave the results of his investigations into Japanese skeletons. For the purposes of the present paper he obtained numerous anthropometrical measurements—about 2500—based on a scheme which included seventy-nine measurements in the case of each individual. It is noticeable that Broca confined himself to little more than a third of this number, Virchow's scheme contemplated thirteen, and at the most thirty-eight, Weissbach sixty-seven, and Quetelet, in his anthropometry, gives eighty-two measurements. The skeleton plan of the paper is as follows: 1. Skin and hair: the colour of the skin and its cause, artificial colouring, including tattooing, the characteristics and nature of the hair; 2. The *physique* in general, including the carriage and gait of both sexes, weight, size, and growth; 3. Measurements of the body and limbs. In the discussion of the results set forth in this section the author expresses the opinion, based on his own investigations, that in general the value of these anthropometrical measurements is much exaggerated by anthropologists and ethnographers.

The tattooing of the skin by Japanese, generally those of the lower classes, has attracted much observation from Europeans, due partly to the extraordinary elaboration and artistic skill displayed, partly to the fact that the occupations and customs of the class in which tattooing is most practised are such as to render it necessary frequently to wear none but the most indispensable garments. This subject has never, so far [illegible] are aware, been examined with so much thoroughness [illegible] as by Dr. Baelz. He says that among the various peoples [illegible] have, in the course of centuries, reached a high state [illegible] culture the Japanese are probably the only race [illegible] retained generally the practice of tattooing and have [illegible] state of highly artistic development. Up to a few years [illegible] practice was so widespread that in Tokio alone there are [illegible] to have been, possibly still are, 30,000 men who were [illegible] This decoration is not confined, as in Western countries [illegible] small part of the body, but it covers the whole [illegible] considerable part of the limbs. The head, neck, [illegible] feet are never tattooed, a circumstance of importance in [illegible] the practice. It was confined to the lower classes; [illegible] better classes it was considered unworthy to disfigure [illegible] in this way. It was widely spread amongst the [illegible] great towns and coolies, and even to-day it is exceptional [illegible] an old man of either of these occupations who is n[illegible] The objects illustrated were various: amongst the m[illegible] were large dragons, lions, battle scenes, beautiful [illegible] historical occurrences, flowers, &c. Dr. Baelz states [illegible] never saw obscene pictures tattooed. The colours em[illegible] black, which appear blue, and various shades of red. [illegible] obtained from Indian ink, the usual Japanese writing [illegible] the red from cinnabar. When a man wishes to un[illegible] process he looks out in a popular picture-book some [illegible] which takes his fancy, or he evolves something fr[illegible] imagination, and goes with it to the artist. The latter [illegible] his arrangements, and sketches the picture on the sk[illegible] is skillful at his calling he sketches the merest o[illegible] straightway introduces all the details; but if he is not [illegible] in himself he first draws the whole picture on the skin. [illegible] is no special ceremony attending the work as in [illegible] South Sea Islands, nor is there any religious significance [illegible] ever in the process. The artist uses for the purpose [illegible] fine, sharp sewing needles, fixed firmly, four, eight, twelve, [illegible] or forty together, in a piece of wood. They are arrange[illegible] several rows; when there are forty they stand in four rows [illegible] each. The points are quite even, except when it is [illegible] produce a light or dark shading, when the needles are arrang[illegible] corresponding lengths. This combination is said to be [illegible] painful. The skin, at the place where the puncturing [illegible] on, is stretched between the thumb and first finger of [illegible] operator, who holds between the third and fourth fingers [illegible] same hand a writing brush with ink or cinnabar, as may [illegible] required, on it. He holds the wood containing the needles [illegible] his right hand, and, having put the colour on them, he rests [illegible] hand on the thumb of his left hand, and then proceeds with [illegible] traordinary rapidity to puncture the skin, stopping every [illegible] and again to put on the fluid anew. Dr. Baelz counted on [illegible] occasion ten punctures per second, and as there were ten needles [illegible] the person being tattooed received one hundred punctures [illegible] second. The wonder is that with such speed excellent pictures, with various degrees of shading, can be produced, but such [illegible] the fact. A skillful operator can in this way puncture the [illegible] or breast and stomach of a grown man in a day. A few [illegible] thousand punctures are necessary for this purpose. The patient, if he may be so styled, does not suffer so much pain as might [illegible] expected. The punctures are not very painful, they tickle [illegible] than hurt. No blood is drawn; a circumstance which [illegible] that the needles do not reach the cuticle, and which also [illegible] the slight pain of the operation, and the possibility of end[illegible] it. This, however, is not the case always, for in many [illegible] the body where the skin is tender, or where a deeper [illegible] required, some clammy blood comes slowly to the surface, [illegible] the operation becomes painful. This occurs most frequently [illegible] the knees and elbows. To be well tattooed, therefore, [illegible] as a sign of manly vigour and endurance. As soon as the [illegible] is over the [illegible] parts are bathed with warm water, [illegible] produces a [illegible] The colour then comes out [illegible] than before [illegible] No special [illegible] ordered. [illegible] feverish [illegible] days the [illegible] never irrita[illegible] [illegible] There [illegible]

[1] Actually two expeditions—one east, the other west.
[2] Dease and Simpson had to pass over about 500 miles of previously [illegible] coast before getting to new ground, but Franklin and Richardson [illegible] new ground at once on reaching the coast.
[3] [illegible] the coast, &c., traced by Rae, 1123 miles were done by [illegible] the most laborious of Arctic work.

ıat it is a barbarous custom unworthy of a civilised people. ut Japanese tattooing is so superior to that of all other nations ıat European sailors are said to look forward to it as the rincipal advantage in a visit to the land of the Rising Sun.

This being the method in which the practice is carried out, r. Baelz comes to discuss its origin and meaning. The oldest ference we have to tattooing in Eastern Asia states that a hinese prince, about three thousand years ago, who was nomin-ed heir to the throne against his will, had himself tattooed in rder to render his succession impossible. But at the present ay the practice in China and Korea has fallen into desuetude, hile in Burmah it still appears to be in vogue. In 1872, a man as exhibited in Europe who had been a prisoner amongst the urmese, and who was tattooed from the crown of the head to ıe sole of the foot. The practice is still prevalent amongst the outh Sea Islanders and the American Indians. In his work on ıe origin of writing, Wuttke seeks to show that tattooing is a kind f writing; but however correct this theory may be in the case of ıe tattooed peoples known to him, it certainly does not hold ood in the case of the Japanese. The signification of the ractice, says Dr. Baelz, amongst the latter is quite distinct from hat which it has amongst other peoples. In the first place, mongst the South Sea Islanders and the Indians, tattooing has religious, a symbolical meaning; it is a ceremonial, frequently a acred process. There is nothing of this in Japan—neither eremony, nor other peculiar meaning; it is done for cosmetic urposes and for no other. Again, amongst other peoples attooing was a species of distinction; it marked the heroes, eaders, chiefs, of the tribe. In Japan it marks a man of the ower classes. Elsewhere, also, the uncovered parts of the body, uch as the face, neck, hands, &c., are the favourite spots for attooing; in Japan it is only the portions usually clothed which re tattooed. It is noticeable that amongst the Ainos the tattoo-ng takes place on the exposed parts of the body, and that it is argely practised by women, two circumstances which distinguish from the practice amongst the Japanese, and in which the Ainos resemble other northern peoples such as the Esquimaux, he Ostiaks, and others. In answer to the question, What neaning has the practice amongst the Japanese, as distinct from ther races? the author replies that in Japan tattooing is a gar-nent, a decoration. Various proofs of this statement are dvanced, amongst them being the following: only those parts f the body are tattooed which are usually covered; all workmen lo not tattoo themselves, but exclusively those whose work auses excessive perspiration, and who can, therefore, work best n a semi-nude state, such as runners, grooms, bearers, &c., and mongst these the practice prevails only with those who have onnection with large towns, where nudity would be objection-ble. Their garments are tattooed on their bodies, and they ppear clothed without clothes before the public. The peasants re never tattooed. Again, the colours of the tattooing corre-ponds with that of the dress; it is the same dirty, dark blue. This theory never suggested itself to the Japanese: they thought hat it must have come from China, and that it was a species of unishment. It was, it is true, at one time the custom to tattoo narks into criminals, but this was confined to a ring on the lbow. It would not explain the spread of the practice amongst ertain classes in certain directions. Dr. Baelz's theory that it is nerely a substitute for dress, and as the wearing of clothes is now compulsory, tattooing has lost its meaning. As for its rigin, the peoples around the Japanese, the Ainos and the Loochooans, have practised it; and the Japanese navigators who ravelled far and wide in the Eastern seas in the sixteenth entury might well have seen it elsewhere. The Japanese dis-overed, says Dr. Baelz, that man can paint a figure on his skin which the rain cannot wash away, the sun wither, or even all-devouring Time destroy, and with their instinctive artistic skill they gradually developed and perfected the original rude figures in idea and execution. At first few only wore this blue skin-[illegible], but these few appeared to their companions decorated and [illegible] (a tattooed person does not appear actually naked), and [illegible] a garment was cheap and lasting, and every man could [illegible] it according to his own fancy, tattooing became the fashion. It may be added here that among the Igorrotos of the [illegible] districts in the north of Luzon tattooing is also [illegible], although it consists rather of a series of [illegible] of one large, elaborate picture. Dr. [illegible] before the Anthropological [illegible] the hands, [illegible] untouched except by one tribe. A picture of the sun, as a number of con-centric circles on the back of the hand, is the commonest object represented. The process takes place at puberty, and is a long one, as the punctures (which are made with a three-pointed instru-ment which is clumsy in comparison with the Japanese needles) become inflamed and take a long time to heal. The tattooing of the Buriks, a tribe of Igorrotos, takes three or four months to complete.

It may not be out of place here to refer to Dr. Baelz's account of the Japanese use of moxa, which, like tattooing, comes into his section dealing with the skin. On the bodies of almost every Japanese, and sometimes on every part of the body, one sees round white spots. These are the moxa spots, produced by burning the flesh with a species of plant, with the object of curing some affection. This is a universal popular specific in Japan, which is its home, although moxa is to be found used elsewhere. It was introduced from Japan to Europe by the Portuguese and Spaniards, and the name is Japanese. In May the leaves of the *Artemisia Chinensis* are powdered and dried, and the mass cut into small blocks or pieces. One of these is laid on the body and set on fire, burning slowly away. At first it naturally produces a sore, more or less deep, according to the intensity of the heat; soon this heals, leaving the scar for ever. The belief in the efficacy of this process is universal, and, Dr. Baelz thinks, not altogether misplaced, for the moxa acts much as our blisters do. Moreover, from the accounts of those who have gone through the cure, it is by no means so painful as one would anticipate from the heroic nature of the remedy.

## *SCIENTIFIC SERIALS*

*American Journal of Science*, August.—Origin of coral reefs and islands, by James D. Dana. The arguments recently raised by Dr. A. Geikie against Darwin's theory of subsidence as an explanation of the formation of *atolls*, or barrier reefs inclosing a lagoon, are discussed and shown to be largely based on mis-understandings of the facts. It is pointed out that local eleva-tions within the sinking area are not evidence against a general subsidence, such local disturbances and faults being almost necessary concomitants of subsidence. The conclusions as to changes of level in the large Pacific groups south of the equator agree mainly with Darwin's views, and the subsidence indicated, according to him, by *atolls*, is shown to be real, not an apparent sinking due to change of water-level.—On the meteorite of Tomatlân, Jalisco, Mexico, by Charles Upham Shepard. The striking peculiarity of this stone, which fell in August 1879, is the prevalence everywhere of octahedral crystals of nickeliferous iron. The specific gravity of the two fragments examined was 3·47—4·43.—On the widespread occurrence of allanite as an accessory constituent of many rocks, by Joseph P. Iddings and Whitman Cross. From its mode of occurrence and association the authors conclude that allanite must now be added to the group of primary, accessory rock constituents, similar to zircon, sphene, and apatite, though much rarer than any of these. In some regions it appears to be quite uniformly distributed through certain types of rock, such as the porphyrites and allied porphy-ries of the Ten Mile District, Colorado.—Crystals of analcite from the Phœnix Mine, Lake Superior Copper Region, by Samuel L. Penfield. These crystals, which occur thickly grouped together on calcite and native copper associated with tabular crystals of apophyllite, are of all sizes from minute particles up to one centimetre in diameter. The small ones are simply tetragonal trisoctahedrons of the form {211}, 2 – 2; the larger ones are of the same form, but with the planes differently arranged.—On a differential resistance-thermometer, by T. C. Mendenhall. This instrument has been devised and constructed for the study of certain problems connected with meteorology, especially the observation of soil and earth temperature, and the use of which would not demand greater skill than that of the ordinary meteorological observer. It consists essentially of a mercurial thermometer, not unlike ordinary forms, except that the bulb is greatly enlarged, so that the stem may have a diameter of about a millimetre, still leaving the scale tolerably open. By its means observa-tions may be taken in less than a minute, no time being con-sumed in the preparation of liquids of known temperature at the observing station, as in the use of the thermo-junction on the resistance coil.—Impact friction and faulting, by George F. Becker. The author discusses the phenomenon of "step faults," as described in Mr. Geikie's "Text-Book of Geology," p. 532, which he concludes to be not merely local, but of general occurrence.—A standard of light, by John Trowbridge. Objections are raised to the standard adopted at the Paris Conference of 1881-4—that is, the light emitted by a surface of platinum at the point of solidification. A more satisfactory standard might be an incandescent strip of platinum radiating a definite amount of energy, this energy being measured at a fixed distance, which will best agree numerically with the absolute system of measures now universally adopted in heat and electricity.—On hanksite, a new anhydrous sulphato-carbonate of sodium from San Bernardino county, California, by W. Earl Hidden. This new Californian mineral has a density of 2·562, hardness 3·—3·5, and is readily soluble in water, yielding an abundant precipitate of barium sulphate when barium chloride is added to the solution. The author names it "hanksite," after Prof. Henry G. Hanks, whose name is so intimately associated with the mineralogy of the Pacific coast.—Mineralogical notes, by Edward S. Dana and Samuel L. Penfield. The chief subjects of this paper are the analysis of a large crystal of hanksite from California and an artificial crystallised lead silicate from the Desloge Lead Company, St. François County, Missouri.—On the amount of moisture which sulphuric acid leaves in a gas, by Edward W. Morley.—Local deflections of the Drift Scratches in Maine, by G. H. Stone. Traces of these indications of secondary glaciation have been observed, especially in the Sebasticook Valley, the Belfast and St. George River districts.—Successional relations of the species in the French Old Tertiary, by Otto Meyer. In these, as well as in the corresponding American formations, many animal and vegetable species can be traced along through the succeeding strata, the latter being apparently connected by descent with the earlier forms. The paper is accompanied by a comparative table of Lower, Middle, and Upper Eocene and Oligocene forms illustrating this principle.

*The American Naturalist* for August contains notices of some human remains found near the City of Mexico, by Mariano de la Barcena.—Evolution in the vegetable kingdom, by L. F. Ward.—The relations of mind and matter, by Charles Morris.—Affinities of Annelids to Vertebrates, by E. A. Andrews. —The use of copper by the Delaware Indians, by J. C. Abbott. —Notes of recent literature, &c.

*Bulletin de l'Académie Royale de Belgique*, June.—Note on some derivatives of tetrabromuretted hydrocamphene, by M. De la Royère.—On certain developments of algebraic series; the general formulas of these developments and their application to special cases, by M. J. Deruyts.—Researches on the action of a beam fixed at both ends and subjected to a movable overcharge, by M. G. Leman.—Questions of indeterminate analysis, by M. E. Catalan.—Note on the motions of the human brain, by M. Léon Frédéricq.—A new process of vivisection for the physiological study of the thoracic organs, by the same author. —On the optical properties of Ludwigite ($R_4FeB_6O_{16}$), by M. A. F. Renard.—Determination of the coefficient of compressibility for some fluids and of the variations of this quantity under different temperatures, by M. P. De Heen.

*Rendiconti del Reale Istituto Lombardo*, July 23.—On the causes and treatment of certain ophthalmic affections (preliminary note), by Dr. R. Rampoldi.—An exposition of the third paragraph of Riemann's memoir on the theory of the Abelian functions, by Prof. Giulio Ascoli.—Further researches on the neutralising agents of the tubercular virus, by Prof. G. Sormani and Dr. E. Brugnatelli.—Toxico-chemical affinities and differences of gelsemina and strychnine, by Dr. C. Raimondi.—On the phenomenon of etherification by double decomposition, by Prof. G. Bertoni.—The mental infirmities and last days of Torquato Tasso, by Prof. A. Corradi.—Note on an artistic palimpsest of the fourteenth century, by Prof. G. Mongeri.—Meteorological observations made in the Brera Observatory, Milan, for the month of July.

*Rivista Scientifico-Industriale*, July.—On the solar spots, their origin, nature, and harmless character, by Prof. ... Ricco.—Application of the telephone to the study of ... columns of gas, by Prof. Fossati.—A contribution ... of etherification by double decomposition, by Prof. ... rtoni.—Geological constitution of Mount Vincigl... oli range, by C. del Lungo and R. Cocchi.

## SOCIETIES AND ACADEMIES

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**Academy of Sciences**, September 28.—M. Bo... sident, in the chair.—Equilibrium of the moon, by ... Tisserand. In this paper calculations are submitted in ... of M. Ch. Simon's theory, supplemented by M. Puis... neglecting the excentricity of the lunar orbit, the ... is displaced in the interior of the moon in such a way ... stantly to oscillate in the plane perpendicular to the ... directed towards the earth.—Note on earthquakes, by ... d'Abbadie. The author gives an account of the seism... ments observed by him last winter in Egypt, where th... graph was exceptionally active. He urges a systemati... these phenomena in France, such as has already be... menced by M. E. de Rossi in Italy, and by Mr. Milne ... —Researches on the nitric cellulose substances (gun co... by M. Ch. Er. Guignet. The constituents and pr... described of the four distinct nitric cellulose bod... determined, all of which may be regarded as derivative... cellulose $C_{48}H_{40}O_{40}$, where 4eq., 6eq., 8eq., or 10eq ... are replaced by the same number of equivalents of ... nitric acid.—Memoir on the treatment of phylloxera b... of the organic sulphurs and the polysulphides of a... obtained by dissolving powdered sulphur in the ... cesspools, by M. J. Jullien. This treatment is ... as inexpensive, thoroughly efficient, and applicable to e... scription of soil.—Note on an unpublished document ... Venturi, dated February 26, 1610, on the invent... the theory of the telescope, recently edited by M. ... This letter, addressed by the writer to the Marquis John ... Manso at Naples, is specially interesting as being ... the earliest publications of Galileo on the telescope w... just been invented by Lippersheim in Holland.—No... separation of liquefied atmospheric air into two dis... by M. S. Wroblewski.—Description of two new type... densing hygrometers, by M. Georges Sire. The ... character of these hygrometers is that the moisture is ... ated on a bright metallic surface without solution of ... Perfect equality of temperature is secured in both ins... by the agitation of the volatile fluid and the thinne... walls of the cylindric tube.—Genesis of the crystals of ... in square tables (five illustrations), by M. Ch. Bru... author's experiments on the genesis of the square ... sulphur show the direct passage from the curve to the ... line in the development of these crystals.—Mor... the mandibule of the hymenoptera, by M. Joannes ... This organ of the hymenopteræ is shown to be perfectl... gous in all its parts to that of the grinding insects.—... the application of thermo-chemistry to the explanation ... logical phenomena, continued; iron ores, by M. Dieul...

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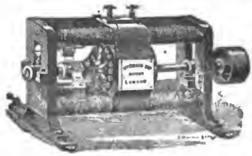

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THURSDAY, OCTOBER 15, 1885

## COMPARATIVE ANATOMY AND PHYSIOLOGY

*Comparative Anatomy and Physiology.* By F. Jeffrey Bell, M.A., Professor of Comparative Anatomy at King's College, London. (London: Cassell and Co., Limited, 1885.)

THIS work is one of a series of "Manuals for Students of Medicine," each of which is to be "compact and authoritative"—"embodying the most recent discoveries," and also to "contain all the information required for the medical examinations of the various colleges, halls, and universities in the United Kingdom and the Colonies."

On behalf of those of our readers who may be unfamiliar with the demands of certain of the examining bodies referred to above, it may be well to state that nothing but a *résumé* of all that is known in the subject could meet the requirements of the case. That which the publishers demand, and which the public therefore has a right to expect under the conditions laid down, is an ultra-condensed digest of all authoritative work in zoology and physiology. Incredible though this may appear to any one acquainted with the bibliography of the subject, Prof. Bell's manual is so far satisfactory that we cannot but congratulate the publishers upon their choice of an author, whose work in connection with the *Journal of the Royal Microscopical Society* and the *Zoological Record* render him *par excellence* the man for this *opus mirabilis.* When it is stated that there are but 548 pp. to the book it will be clear that it must be a vast collection of facts, little being left as to style or originality for that criticism which the author invites. The method of treatment, however, is somewhat novel, and in our opinion open to comment.

The author divides his work into fourteen chapters. Of these the first is introductory; the second is devoted to the Amœba as a physiological study; the third to "the general structure of animals," that is, to a consideration of the "broader characteristics of the groups into which the animal kingdom has been divided." Those which remain are devoted, each to one of the great systems of organs and to development.

In estimating the value of this volume, it must be clearly borne in mind that it is a book intended for beginners. Chapter II. is written for biological babes, and it will be clear to any one who reads the volume that the author would have the student familiarise himself with the facts in the order in which they are presented to him. This being so, it is a pity that Chap. I. should have been so largely devoted to the subtle details of cell-structure; the beginner is lost in descriptions of the "cytod" and the "cell," for each of which broad differences are dogmatically formulated, such as would tend to bias the mind of the average student. Draw hard lines by all means for the beginner, but not in such delicate matters as these. Only by working from the known to the unknown, can the student of science ever hope for success; the order of his elementary studies must be a recapitulation of that in which the science itself has advanced—he must here begin with gross anatomy, and we believe that to treat first of the subtle details of cell structure is to do violence to the cause of inductive science. A somewhat similar comment may be offered upon the manner in which the great phyla are dealt with in Chap. III. Having devoted nearly half the chapter to defining these, the author proceeds (pp. 58, 59) to deal with types of each. He prefers to commence with the Echinodermata, dealing thus "first of all" with the "most aberrant" phylum. If the Echinoderms are dismissed as a stumbling block, why not the Brachiopods, the Polyzoa, and certain other creatures well known to zoologists? These are all wisely relegated to the end of the chapter, as "groups of animals which in the present state of our knowledge cannot be satisfactorily placed with any of the great phyla" (p 100). Just so, but why not put the Echinoderms there also If the student is to be allowed the exercise of any judgment in the matter, he cannot be expected to deal with the aberrant before he is familiar with the normal, and more stereotyped grades of organisation.

Although the work is professedly a text-book of comparative anatomy and physiology, the latter branch has suffered much in the process of condensing, necessary we presume in order to keep the book within the prescribed limits. At the commencement of each chapter a concise definition of that system of organs to be dealt with comparatively is given, together with a brief description of their functional activity; but the field of comparative histology is sorely neglected. The author neither furnishes the required information on this subject, nor does he take for granted that his readers have worked through even the broad principles of it. The student is occasionally referred (*Ex.* pp. 368 and 372) to Klein's "Manual of Histology"—a fellow volume to the one now before us; but as that work deals with the subject altogether from a special human-anatomist's point of view, the reader is at a loss to make much of the subtle differences in the comparative anatomy of, say, shells and teeth, until he knows more precisely than he is here informed what is involved in an exoskeleton and a tooth. Similarly, the statements made (p. 258) concerning the vertebrate excretory system are altogether too brief and dogmatic. The student is merely informed that *Meso* and *Metanephros* exist; of their adult structure he learns little or nothing, and in the face of such descriptions of the essential structure of an excretory organ as are given, he would be at a loss to make much of that of the vertebrate at any rate for himself.

Chapters V. and VI. are also at a disadvantage from this curtailing of the histological portion of the subject. The definition of the blood given (p. 181) would not convey to the beginner's mind a notion of its real complex nature; he would rather infer that it is merely "the result of the process of digestion," in function "respiratory as well as nutrient." Least successful of all the definitions given of great systems is that (pp. 393-94) of the nervous system, and it is exceedingly unfortunate that (p. 411) the nerves should be described as bringing or carrying "messages." A fascinating conception of the nervous activity this may be, but it is a commonplace one, well known to every teacher of physiology; the mischief attendant upon its use is patent, and it is highly desirable that special efforts should be made to secure its abolition. Its adoption in this work is therefore greatly to be regretted.

Prof. Bell's book is fully up to the date of writing, and the subject-matter is for the most part judiciously selected and arranged; but in a volume where so much of fundamental importance to the student is recorded, we could wish to see more discretion used in the transcription of certain hypotheses. We frequently find the most elementary facts set down side by side with the most daring generalisations. Nowhere is this more conspicuous than on p. 85, where Hubrecht's well-known Nemertean-Vertebrate hypothesis is referred to. The author mentions this with a caution it is true, but its introduction in the manner adopted, and with the illustrations given, is out of place. Again, a teacher is not justified in telling a novice as a *procès verbal* in an elementary text-book that "the Echinodermata, the Arthropoda, and the Mollusca form (p. 84) three very distinct branches or phyla, the common ancestor of which is to be sought for only in a simple worm." Neither is he justified in asserting (p. 403) without further qualification than is here given, that "with the exception, then, that in Peripatus and Proneomenia, the anterior end of the nerve-cords is enlarged into a cerebral mass, we should appear to be able to see no essential difference between them and a Craspedote Medusa, save in fact that the Medusa has a complete nerve ring." Statements such as the above may prove in the long run to be expressive of the truth, but if introduced into a text-book, efforts should be made to convey to the mind of the student some notion of what they involve. The beginner is too ready to rely upon his teacher and his text-book at all times, and the admixture of elementary facts with startling hypotheses is—in a work of this order—directly opposed to the true scientific principle. The natural tendency to generalise prematurely needs to be checked rather than otherwise, and if countenanced by a teacher, it must lead to fallacies greater and more mischievous, than were those of the catastrophic school.

There is a dangerous sketchiness about certain portions of this work. For example, on pp. 165 to 193 there is instituted a brief comparison of the great blood-vessels in the leading groups of animals. The descriptions given would lead one to infer that the antennary, hepatic, and sternal arteries of the Crustacean, and the auricles of Mollusca, are serial homologues of the circular commissures of a worm (here called "transverse"); this is in fact stated (pp. 186, 189) to be the case. The argument used above applies equally well here, and we are at a loss to imagine the state of him who, with the aid of this book, shall try to ascertain the actual condition of these vessels in the admittedly all-important worm.

When we reflect upon the advisability of placing this work in the hands of the average medical student, it must be admitted that it is not calculated to be of much service to him during his ordinary student life, e[illegible] a cram-book for the examination-room. The a[illegible] by the terms of his agreement, pledged himself t[illegible] a *précis* of all that is of first importance on the [illegible] The work will be very valuable as a remembran[illegible] book of reference to those who already know some[illegible] definite of the broad principles of the science, and [illegible] conceive of it as calculated to be of especial service [illegible] geologists and others, whose work among the "dry bones" occasionally needs the light from within. So far as the [illegible]dical student is concerned, it must be [illegible] [illegible]rtaught, and it is monstrous [illegible]

exist systems of medical education, such as have neces[illegible]tated the production of this book as a "Manual [illegible] Students of Medicine." The days for "signing [illegible] attendances on long courses of lectures upon zoology a[illegible] botany are—or ought to be—numbered; and if, a[illegible] most desirable, the biological leaven is to be introd[illegible] into the medical curriculum, it can only be done to [illegible] purpose along lines such as have been successful[illegible] down, mainly by Prof. Huxley.

There is undoubtedly a need of a sound elemen[illegible] book, which shall be up to date, on "the general str[illegible] of animals," and Chap. III. of this volume supplies [illegible] want in a measure. The paucity of certain parts of [illegible] however, is a serious obstacle to its adoption, for diag[illegible] such as are given for the Scaphopoda (p. 82), for [illegible] Copepoda (p. 68), and for the Siphonophora, are of [illegible] avail.

Taking the book as a whole, the success with w[illegible] the author has performed his task will be obvious t[illegible] one cognisant of the immensity of the field. Small e[illegible] cannot well be excluded from a work of this kind, b[illegible] volume contains some which ought to be rectified as [illegible] as possible. For instance, there is no good grou[illegible] stating (p. 359) that the sesamoids are "no doub[illegible] explained by a reference to the primitively mul[illegible] condition of the vertebrate limb," and there is some[illegible] akin to a contradiction in the assertion (p. 140) that t[illegible] teeth are "developed from cells of epiblastic origin," a[illegible] that there is "a community of origin between what h[illegible] been well called dermal denticles and what we call tee[illegible] One remarkable instance of the manner in which [illegible] of observation may be spread and distorted in the p[illegible] of abstracting, is to be found on pp. 301 and 377, w[illegible] we read that the telson "sometimes, though very [illegible] (Scyllarus), *bears minute appendages*." We mention [illegible] as the author lays stress upon it, and unless we are [illegible] taken in the identity of the paper from which the abov[illegible] has been culled,[1] an attempt was merely made to [illegible] —and that unconclusively—that "the telson is a [illegible] body segment with lateral appendages, which are [illegible] by cohesion and adhesion." He who abstracts can[illegible] expected to verify the accuracy of every stateme[illegible] reproduces—life is too short for that—but a matter [illegible] the above should not have been allowed to pass. In de[illegible] the Arachnida (p. 72) it is stated that "the mouth is n[illegible] placed so far [illegible] any of the appendages be[illegible] antennary [illegible] but one view of a complica[illegible] and deeply [illegible], even should it cha[illegible] to be true [illegible] a deduction [illegible] and its use [illegible] is unwarr[illegible] same deduction [illegible] [illegible]ner a similar [illegible] [illegible] uncalled for [illegible] [illegible] process [illegible] from the [illegible] [illegible]plete misun[illegible] imperfect roof" in the region of the fore-brain, hardly accords either with fact or with the characters delineated in Fig. 138. In dealing with another complex matter—the origin of the fœtal membranes—the student's attention is abruptly transferred (p. 509) from the vitelline membrane to the amnion, and that in such a manner that he would scarcely follow what is really meant. Closely allied is the description of the germinal layers, and we doubt if the bare statement (p. 34) that "the outer and inner layers undertake the functions which their position entails on them" is justifiable.

The work is got up in good style. The technical terms are printed in large type, but the choice of these is not always happy; on p. 5, for instance, in describing the movements of living protoplasm, we find the words "stream" and "gliding" set up in large letters; while, on p. 12, where the time-honoured terms "ontogeny" and "phylogeny" cannot well be dispensed with, neither they nor equivalents are employed—in fact, but for the aphorisms quoted on p. 13, the arguments used under the head of "development" would hardly carry conviction. Considering the nature of the book there are very few typographical errors. The more important are: p. 49, the description of Aspidogaster as "*ecto*parasitic;" p. 138, the "*anterior posterior* of the digestive tract;" and, p. 501, "the *cephalous* Mollusca, such as the mussel," &c. The illustrations are, for the most part, fairly good. Fig. 11, representing, as it does, only one-half of an anemone, is not easily intelligible to the reader, and the student should be informed what the right half of Fig. 22 is intended to illustrate. Fig. 66 illustrates but feebly part of an important subject—Mammalian odontology—which is poorly dealt with. Figs. 36, 42, 81, 82, 101, 170, and 192, are all out of place in a work of this kind. They convey little or no impression to the mind of the student, and are bare schemes such as an observer might construct for use in his own private notebook *side by side with actual drawings of the facts observed.* Diagrams such as Fig. 101 should never be shaded up, as if indicative of actual appearances.

To sum up. The author has successfully produced, at immense labour, a volume, of service to those who already possess a practical knowledge of the broad principles of the subject. A "Manual for Students of Medicine" it emphatically is not, except under that atrocious and misdirected *régime* of parrot-work not yet extinct. For this the system, and not the author, is to blame; he has performed a good service, the return for which will but ill repay him.

G. B. H.

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## *BRITISH DAIRY FARMING*

[illegible]*sh Dairy Farming.* By James Long. (London: [illegible]man and Hall, 1885.)

[illegible] readable volume is from the pen of one who [illegible] understands the highly technical subject [illegible] devoted himself. Writing upon agri- [illegible] attempted by mere theorists, [illegible]e practical men have been [illegible] forthwith consign both [illegible] department more [illegible] not book-writers [illegible] Mr. Long is happily able to exercise the discernment which comes of knowledge in the marshalling of his facts and the quality of his suggestions. In his introductory chapter he gives solid statistical reasons why we should as a community endeavour to "produce more and import less," and the subsequent chapters are devoted to a review and comparison of our dairy system and those of our Continental neighbours, much to the advantage of the latter. The genius of the English farmer does not appear to have as yet shone into his dairy. His fields, his machines, his cattle stalls, his animals, have each and all been the admiration and the model of Europe and America. But he pauses on the threshold of his dairy and, we may add, his hen-house. These are, he thinks, the proper domain of the dairy-maid or the housewife, and the farmer is done with the milk when he has set it down at his dairy door.

It is a case parallel with that of our *cuisine*. We produce the finest beef and mutton, but we are only too constantly reminded of the forcible old proverb that while God sends meat the Devil sends cooks. There is some ground for hope that we shall, if only by force of competition, be compelled to further elaborate our products. English cheese is excellent, but it is lamentably wanting in variety, and certainly is much too apt to be regarded as one of the necessaries rather than as one of the amenities of our daily fare. Butter-making offers fewer facilities for innovation, but much requires to be done before we can successfully compete with the butter-makers of Denmark, Normandy, and Brittany. It is to cheese-making that Mr. Long devotes the largest share of his space. In England the principal cheeses may be almost told off upon the digits of one hand: they are "Stilton, Cheshire, Cheddar, Gloucester, Derby, and Leicester." The two last are, however, a little less definite than the first four, and we do not quite see their right to continue a list so well begun. Derby and Leicester are, no doubt, very good cheeses, but if they are to be admitted to stand in the same relation to English dairying as Stilton and Cheddar, we think Mr. Long might well have increased his list by adding Cutherston, Dorset-blue, North Wilts, and other cheeses well known to thousands of admirers. The principal English cheeses are, however, undoubtedly the first four mentioned in Mr. Long's list, and, with the exception of the Stilton, none of them can compare, in the estimation of an epicure, *connoisseur*, or *gourmand*, with the soft, rich, palatable cheeses imported to this country under a puzzling variety of appellations.

The chief interest of Mr. Long's book consists in his minute workable descriptions of the manufacture of a large number of cheeses, which indeed appear to be as numerous and various as are different sorts of wines. The book is well illustrated, and the "plant" required for carrying on the manufacture of some of the cheeses is complicated and expensive. Still, there appears to be no reason why similar cheeses should not be successfully made in England, and it is not improbable that the processes would be further improved in English hands were the matter once taken up.

Take, for example, Camembert:—

"The rennet is added to the milk at a temperature similar to that at which it is drawn from the cow: it is heated in a tub, and a portion of the morning's milk is added to the milk of the previous evening. . . . When the rennet is added the milk is gently stirred with a long spoon for two or three minutes; a wooden cover is then placed on each pan, and it is left for five or six hours. . . . The curd is then taken out by spoonfuls and put into cylindrical white metal moulds which cost about 4*s*. 6*d*. a dozen, and which are open at both ends. These are previously placed upon rush mats upon slightly inclined tables, and which have on the lower extremity a small gutter which carries off the whey into a receptacle beneath. . . . When the curd has remained two days in moulds the cheese possesses consistency enough to enable it to be moved with ease. Then the left hand is placed beneath it, and, assisted by the right hand, cheese and mould are turned, so that the top face is placed at the bottom, in contact with the mat. At the end of thirty-six to forty-eight hours from filling, the cheeses are taken out of the moulds and salted. . . . When salted, they are placed upon the wooden shelves above the draining tables, and here they are left for two or three days until they are ready to be sent to the *hâloir*."

We have quoted the foregoing passage in order to show that there is nothing more complicated in the making of a French Camembert cheese, nor yet so complicated, as in the making of an English Cheddar. Whether by following Mr. Long's directions an English dairyman could produce the correct type and flavour can only be demonstrated by trial, but probably a cheese would be produced suitable to English methods which would add to the variety of our dairy products and find a ready market. Mr. Long also describes the manufacture of various other cheeses, among which are Pont l'Evêque, Livarot, Mignot, Boudon, Brie, Géromé, Coulommiers, Mont d'Or, Void, Suisse, St. Remy, Gervais, St. Marcellin, Jour iac, Gex, and a large number of others, the mere mention of which would occupy more space than we can spare.

Mr. Long has certainly contributed a handy text-book which it is hoped will find its way among and be studied by dairy farmers.

JOHN WRIGHTSON

## OUR BOOK SHELF

*Chain Cables and Chains.* By Thomas W. Traill, C.E., R.N., the Engineer-Surveyor to the Board of Trade. (London: Crosby Lockwood, and Co., 1885.)

IN the volume before us we find the business of chain cable-making in its several branches well explained and illustrated; nor does the aim of the author end here. There is information given which is most useful to surveyors and inspectors, and we recommend all who have to deal either with the manufacture, inspection, or testing of chain cables to study the work. The volume contains many well-executed plates, showing good, bad, and indifferently-formed links, &c., for various kinds of cables, also tables of the best dimensions of each part of each link and shackle used in cables from 7-16th to 2¾ inches, the dimensions being given in decimals to two places, and also calculated to thirty-second parts of an inch. We find also exact copies of certificates given by the several public proving establishments, seven plates in all, more than one example being quite unn[illegible], varying as they do only in colour and the [illegible] town in which the establishment happens to [illegible]

After a few pages giving an outline of [illegible] manufacture and the methods of welding t[illegible] have a long historical chapter of the early uses [illegible] chains, in which we are told that their uses date [illegible] the time of Pharaoh and King Solomon; but it [illegible] until 1808 that chain cables were used on board shi[illegible] this time a chain cable was used in a vessel called [illegible] *Ann and Isabella*, of 221 tons, built at Berwick, [illegible] owned by Joshua Donkin. This cable was made [illegible] Robert Flinn, in North Shields, perhaps the first [illegible] in chain cables. In the year 1833 the first machine f[illegible] testing iron cables in a Government yard was put [illegible] at Woolwich, and in 1834, although chain cables [illegible] almost in general use, the rules of Lloyd's Registry [illegible] specified the length, and it was not until twelve [illegible] afterwards it was part of the surveyor's duty to see [illegible] they had been properly tested. The author gives [illegible] interesting account of the progress of manufacture [illegible] general adoption of iron cables. We then find the [illegible] Acts of Parliament pertaining to their use given [illegible] All public proving establishments are now under [illegible] management of Lloyd's Committee.

The method of proving chain cables is as follow[illegible] From every length of 15 fathoms of the cable [illegible] proved a piece consisting of three links is taken and [illegible] jected to an appropriate breaking-strain. If the pie[illegible] selected fail to withstand such a breaking-strain, a[illegible] piece of three links is taken from the same 15-[illegible] length and tested in a like manner. If the first or se[illegible] of such pieces withstand the breaking-strain, the rem[illegible] ing portion of the 15 fathoms of cable is then sub[illegible] to the tensile strain. If it is found that after the ap[illegible] tion of the tensile strain the cable is without defec[illegible] flaws, it is then stamped as proved with the disting[illegible] marks of the proving establishment; on the other [illegible] should the cable fail to stand the appropriate tests [illegible] rejected. Mr. Traill condemns the overtesting of c[illegible] considering that the material is injured by so doi[illegible] we agree with him in saying:—"A moderate tes[illegible] that is not detrimental. Proving the iron from wh[illegible] cable is made, and breaking a sufficient number of sa[illegible] is what can and should be done to prove the actual q[illegible] and reliability of a chain."

The volume does great credit to the publishers, [illegible] well printed on good paper. We can safely recom[illegible] this work to all in any way connected with the ma[illegible] ture of chain cables and chains as a very good book[illegible]

*United States Coast and Geodetic Survey. Determi[illegible] of Gravity at Stations in Pennsylvania, 187[illegible] Appendix No.* 19. *Report for* 1883.

THIS appendix is a portion of the Annual Rep[illegible] the U.S. Survey, and contains the pendulum obser[illegible] made in 1879-1880 by Mr. C. S. Peirce at three st[illegible] in Pennsylvania—namely, at the Alleghany Observ[illegible] at Ebensburg, and at York. The observations form [illegible] of a series undertaken in connection with the Ge[illegible] Survey of the United States. A Repsold reversible [illegible] dulum was used and oscillated *in vacuo*, using va[illegible] kinds of supports. At York a series of experiments w[illegible] made to determine the effect of the flexure of the sup[illegible] It appears from a previous report (Appendix No. 1[illegible] 1881) that Mr. C. S. Peirce maintained against [illegible] Plantamour and Hirsch in Switzerland, that the [illegible] tions of the [illegible]ve a marked effect on the tim[illegible] oscillation [illegible]ulum, and he accordingly [illegible] took an [illegible] of experiments to prove [illegible] point, and [illegible]allowance to be made [illegible] experiment[illegible] No. 19 [illegible] portion, and [illegible] No. 14, with [illegible] disposed of in A[illegible] that the flexure [illegible] [illegible]nt, and it is e[illegible] [illegible]pport is of vi[illegible] [illegible] at York to [illegible] cylinders for the usual knives was also tried, and every care taken to prevent the inclusion of dust, but the results were very unsatisfactory.

The results obtained are as follows:—

Length of second's pendulum reduced to sea-level at the equator.

| | Metre. |
|---|---|
| Alleghany Observatory ... ... ... ... ... | 0·9909384 |
| Ebensburg ... ... ... ... ... ... ... ... | 0·9910672 |
| York ... ... ... ... ... ... ... ... .. | 0·991015 |

At Alleghany, the effect of a valley was not taken into account, as there was no topographical survey available; the necessary correction will slightly increase the above value.

## 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. No notice is taken of anonymous communications.*

*[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]*

### The Presence of the Remains of Dicynodon in the Triassic Sandstone of Elgin

In my address to the Geological Section of the British Association I was fortunately able to announce a discovery which is of the very greatest interest both to geologists and biologists. As this discovery was made only a few days before the commencement of the meeting at Aberdeen, and after the draft of the address was in type, it does not appear in your columns; I will therefore ask you to insert this note upon the subject. Visiting the "Cutties Hillock" quarry near Elgin early in September, I found that the workmen had recently obtained a new specimen of a reptile, in which the head was preserved. On examining this I found that there were clear indications of two large canine teeth in the upper jaw with permanent pulp cavities. These characters and the general form of the skull left scarcely the smallest doubt in my mind that the remains must belong to a reptile closely allied to *Dicynodon*. From the examination of a photograph which I submitted to him, my friend Dr. Traquair was able to fully confirm this conclusion, and to lay a preliminary note on the specimen before the Geological Section at Aberdeen. I hope that ere long he will be able to give a complete description of it.

As Dicynodonts have hitherto been only found in South Africa, in India, and in the Ural Mountains, this discovery is an exceedingly important one. Seeing that doubts have been expressed concerning the Triassic age of the South African deposits, the occurrence of the very characteristic African form in the Trias of Western Europe is an important link in the chain of evidence by which these beds have been correlated. It is interesting, too, to be able to point out that the sandstones of Elgin, concerning the age of which such a great amount of controversy has taken place, have now yielded reptiles belonging to no less than *four* orders—namely, the Lacertilia, the Crocodilia, the Dinosauria, and the Dicynodontia.

J. W. Judd

### An Earthquake Invention

While on a visit to the Melbourne Observatory I saw Nature of July 2 containing two letters from Prof. Piazzi Smyth, intended to expose a piratical attempt on the part of a "B.A. man" to adopt an idea of Mr. David Stevenson with regard to the construction of houses to withstand earthquake motion. The publication of the first of these letters is at the [illegible]est of Mr. D. A. Stevenson. The piracy referred to by [illegible] Smyth is a brief note in a paper written by myself. My [illegible] the head of it (see *Report* to the B.A. 1814). Prof. [illegible]ins that I have not taken notice of a paper written [illegible] ago by Mr. D. Stevenson. I regret to say that I [illegible] that paper, and how Prof. Smyth expects [illegible] 10,000 miles away from collections [illegible]. I am, however, acquainted [illegible] aseismatic tables, and if I [illegible] David Stevenson, I must necessarily have referred to the work of others. As every report which I have hitherto written for the British Association has been in the form of notes which have subsequently been expanded in special papers, an historical account of aseismic tables would have been out of place. Prof. Smyth is apparently only acquainted with the work of Mr. D. Stevenson. Under the head of aseismic tables I include ball and plate seismographs, the lamp tables in certain Japanese lighthouses, two model houses which I constructed in Japan, together with the model lighthouse spoken of by Prof. Smyth, and my own dwelling house. *All of these involve the same principles, and they only differ in their dimensions.*

(1) *Ball and Plate Seismographs.*—Of these seismographs I have constructed *several* types. At the time of an earthquake, in consequence of acquiring a surging movement, they fail to give reliable records. They have been *independently* invented and described as original by many. Mr. Briggs, of Launceston, Tasmania; Dr. Verbeck, of Tokio, Japan; Mr. T. Gray, of Glasgow; Mr. D. A. Stevenson, of Edinburgh, &c., have all been authors of such instruments.

Mr. D. A. Stevenson recently figured and described his form of seismograph in the pages of Nature. If we overlook certain mechanical defects in this instrument, as, for instance, attaching a recording index to the edge of the "steady plate" rather than at its centre of inertia, the resemblance of Mr. Stevenson's contrivance is strikingly like a seismograph the photographs and descriptions of which existed in several societies and libraries in Britain prior to the appearance of Mr. Stevenson's invention. After reading Mr. Stevenson's description I did not ask for the publication of an "interesting" and "well-put" letter, accusing Mr. Stevenson of having appropriated the ideas of others, but I furnished him with copies and references to papers in the *Transactions* of the Seismological Society and other periodicals where mention was made of this type of instrument.

(2) *Lamp Tables.*—As I have been an officer in the Public Works Department of Japan for the last ten years, where I have every facility of knowing what the performance of the lamp tables at the lighthouses has been at the time of severe earthquakes, I trust that some credence may be given to what I may say on this subject. When I last made inquiries about these tables, I found that they were all regarded as failures and one and all had been clamped. If Mr. Stevenson would like to have details respecting these failures I shall, on my return to Japan, have great pleasure in making them public.

*Mr. Mallet, in his "Palmieri's Vesuvius," very distinctly states that he was consulted by Mr. Stevenson respecting the Japanese structures, and that the principles indicated by him (Mallet) were followed out in their construction.*

As Mr. Mallet is dead, perhaps Mr. Stevenson or Prof. Smyth will kindly enlighten us as to the meaning of this passage. Although I have made seismology a speciality for some years, I must confess that I am as yet in the dark as to who was the first inventor of the aseismic joint. To me it appears that there have been many inventors.

(3) *Models.*—My first model was about as large as a good-sized dog kennel. For a *short*-period oscillatory movement the house resting on its rollers remained at rest. Prof. Smyth speaks of Mr. Stevenson having imitated earthquake motion by the blows of a sledge-hammer. Although Prof. Smyth regards the blows of a sledge-hammer as an admirable illustration of earthquake motion, any one acquainted with the true nature of earthquake motion would decline to recognise Mr. Stevenson's test as any test whatever.

(4) *Building.*—The only *building* placed on free foundations with which I am acquainted is the one I have erected in Tokio. At first it rested on balls, and, like Mr. Stevenson's lamp tables, it was for certain reasons a failure. Now it rests on spherical grains of cast-iron sand. It is now astatic, and I regard it as a success. At the time of an earthquake the motion outside the house is usually about six times what it is inside. A description of it will be found in the *Reports* of the British Association for 1885.

From what I have now said it will be clear that I have no desire to claim the authorship of the aseismatic joint. Detailed reference to the obscure and manifold authorship of what has hitherto proved a failure would certainly have been out of place in the report to which Prof. Smyth has referred.

Had Messrs. Stevenson and Smyth been acquainted with the nature of earthquake motion, a few of the more important facts in the history of the ball and plate joint, and the details of the failure of the tables in the Japanese light-houses, I feel sure that much of the objectionable innuendo to which I have been subjected would never have been penned. JOHN MILNE

s.s. *Waihora*, Hobart, Tasmania

P.S.—The above has been written whilst at sea, and I have neither had opportunity to refer to books or papers. On my return to Japan I shall be glad to continue the history of the ball and plate joints, should it be required.

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### Tremble-terre du 26 Septembre, 1885

UNE seule secousse a été constatée le 26 Septembre à 0h. 58m. du matin ; elle a été composée de 2 à 3 oscillations, de direction variable suivant les localités. Le centre de la secousse a été dans le milieu du Valais, où son intensité a été appréciée comme très-forte, mais où il n'y a cependant pas eu de dégâts matériels ; il faut lui attribuer le No. VI. de l'échelle qui évalue en dix degrés l'intensité des tremblements de terre.

La secousse s'est étendue vers le nord jusqu'à Schwenden et Zweisimmen dans le Simmenthal, à Château d'Oex, Aigle et Yvorne ; dans les Alpes vaudoises elle a été fort bien sentie dans les vallées de l'Avençon, de la Gryonne, de la Grande-eau, et de la Savine. Dans tout le reste du canton de Vaud le tremble-terre semble avoir passé inaperçu, tandis qu'il nous est signalé de deux localités fort distantes, Genève et Nidau ; il est cependant probable que la secousse de Nidau a précédé de quelques minutes la grande secousse du Valais ; d'après un observateur très précis la secousse de Nidau a eu lieu à 0h. 53m.

En même temps que le sol de la Suisse était ainsi ébranlé, les appareils très délicats de l'observatoire sismique de Rome, qui avaient été en repos les jours précédents, ont signalé des vibrations du sol vers 1 heure du matin ; et dans le même nuit un violent tremblement de terre ravageait la ville de Nicolosi près de Catane en Sicile. F.-A. FOREL

Morges, 8 Octobre

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### Larvæ of Cerura vinula

LAST year I was rearing up some larvæ of *Cerura vinula*, the Puss Moth, from the egg, and I determined, while I had the chance, to write a life-history of them.

On examining the egg closely I found a small hole in the apex of each, and I thought at the time that this was probably caused by ichneumons, and therefore I laid the eggs by in a small box that I might capture the ichneumons when they made their appearance. Great was my surprise, then, when I found that the young larvæ came out as usual.

I therefore determined to get some more eggs and to find out whether this hole in the apex was caused by the mandibles of the larva inside, but I found that the larva did not emerge by this hole, but by a fresh one made in the side of the egg. And I find that all Puss Moth eggs have this hole in the apex.

I am now hoping to get some eggs of moths belonging to the same family (*e.g. Cerura furcula* and *bifida*) to see if they also are perforated in this way. I should be much obliged if any one who has got any of these eggs would kindly let me know whether this is the case.

This hole reaches through the shell of the egg, but is covered, on the inside (of the egg) with a thin tissue, like that which is found in birds' eggs.

I have carefully examined several scientific books, but have been unable to find this fact mentioned ; therefore I should be much obliged if any one would throw a light on this mysterious fact.

I unfortunately have none of these eggs to forward as examples ; but, as they are pretty common in May and June on poplar trees, I have no doubt that such of your readers as are interested in the subject will be able to examine them for themselves. CYRIL B. H[illegible]MAN HUNT

[illegible] Lodge, Fulham, October 9

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### Pulsation in the Veins

I AM quite satisfied that the pulsatory movement in th[illegible] to which my former communication referred, is not in a[illegible] *abnormal*, as suggested by Mr. Williams (p. 490). In *all* [illegible] without exception—and they have been a good many—in wh[illegible] I have had opportunity for the observation, the minute *tin*[illegible] [illegible] of the pulsatory action has been present, and I have invariably been able to count the pulse of the individuals [illegible] the experiment detailed in my former letter.

The mirror experiment was tried on my own hand. [illegible] medical friend who applied the sphygmograph in the usual [illegible] informed me that my pulse was free from any abnormality.

It is to be borne in mind that the pulsatory indications [illegible] which my paper is concerned are exceedingly minute and [illegible] escape the perception of nine persons out of ten—requiring [illegible] eye educated to appreciate very minute differences of shade [illegible] colour. I do not think that the bristles or sealing-wax [illegible] which a correspondent (p. 437) kindly suggests, or eve[illegible] orthodox sphygmograph would have a chance of e[illegible] exhibiting them. I say shade *and colour*: for when a ve[illegible] from turgidity, and not sensibly altering the smooth [illegible] the skin, is seen only by its blue track, a modification [illegible] *tint* is perceptible (to an educated eye) ; and the blue va[illegible] intensity with the pulsatory action, sufficiently for the [illegible] the pulse-counting experiment. J. HIT[illegible]

Stoneaston Park, October 4

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### Stonehenge

IN NATURE, vol. xxxii. p. 436, R. Edmonds [illegible] Stonehenge with the metonic cycle, and quotes Diodorus Siculus, whom he says flourished about [illegible] Would not the latter part of the first century [illegible] more accurate? He gives in his extract from [illegible] Siculus a quotation from Hecatæus, whom he conf[illegible] Hecatæus of Miletus, when it was Hecatæus of A[illegible] whom Diodorus referred. Hecatæus of Miletus flour[illegible] 500 B.C., and Hecatæus of Abdera about 300. M[illegible] Elton, M.P., in his "Origins of English History," give[illegible] same extract, and says that "We cannot admit that the [illegible] Hecatæus is on the subject of Ancient Britain," and [illegible] its value in the following extract from the works of an [illegible] Polish scholar (Lelewel, Pythéas, 45): "Hécatée a [illegible] fameux ouvrage dont le titre décèle une vieille [illegible] rajeunie sous sa plume. Elle devait s'allier aux [illegible] découvertes et y prendre une place éminente au [illegible] de la science et du bon sens. Hécatée, énumér[illegible] les êtres mystérieux de la géographie septentrion[illegible] richit leur nomenclature d'une rivière Scythique [illegible] ment trouvée en Orient par le conquérant, qu'il a [illegible] Parapamisos ; et plus encore des promontoires et de[illegible] iques, qu'il a probablement puisées dans les relations [illegible] de Pythéas pour les entrelacer dans les pages super[illegible]

The quotation from Diodorus is from his second b[illegible] the whole of this second book is dedicated solely to [illegible] tion of Asia ; and it is not until the fifth book is reach[illegible] he describes the British Isles, and with a very co[illegible] degree of accuracy. (See Fergusson's "Rude Stone [illegible] ments," p. 8).

I do not think, either, that "Nine Maidens" is [illegible] abbreviation of "Nineteen Maidens," for, like "Nine [illegible] of Stanton Moor, in Derbyshire, it is a memorial circle.

Stone Henge, moreover, is much more probably a m[illegible] circle, as its original name implies—"Stan Hengist"; [illegible] memorates the massacre of Vortigern's chiefs by He[illegible] 462 A.D. The Kellinght circle probably commemorate[illegible] victory of Rollo over Eadward, circ. 913, whilst Arthur [illegible] Hakpen (520), Kit's Coty House (455), Long Meg [illegible] Daughters (508–520), Stanton [illegible] (508–520), Arthur [illegible] Arbor Lowe, Cumrew, S[illegible] borough [illegible] some of the victories of [illegible] be mentioned the facts [illegible] A.D.), Constantine the G[illegible] min have been found at o[illegible]

Milverton, Leamington

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### The Forecasting of [illegible]

[illegible] paper published in the *J*[illegible] [illegible]y, vol. x., p. 219, 18[illegible] [illegible] the barometric [illegible] months, and in some cases even twelve months beforehand. The facts brought forward in that paper were of such a nature that, as will be readily understood, I wished very much they could be found to occur generally. But it was undoubtedly better to restrict their application to the area and period dealt with in the paper. It having been shown, however, that at one period and over a certain area quantitative relations had existed between previous and subsequent barometric variations, it is natural to suppose that quantitative relations may be found to exist at other periods and over other areas also. The question arises, Can the facts brought forward in the above-mentioned paper serve as a guide to future investigation? I think to a certain extent they can.

The paper pointed out that there was a remarkable approach to an annual symmetry in the abnormal variations of the barometer in Western India during many of the years under observation. It supposed that this symmetry would have occurred every year during that period had it not been masked by larger variations of another character; and it was mainly by acting on this supposition and noting the departure from symmetry in any given year, and by considering that departure as being an index of the variation that was about to come, that the position of the barometer in the subsequent year was calculated. The paper attempted to explain the occurrence of this annual symmetry in two ways: (1) By supposing it to be a constant phenomenon connected with the annual double oscillation known to be present in the normal barometric curve; and (2) by supposing it to be a chance phenomenon, characterising a phase in the march of barometric variations, and persistent during the period dealt with, but not necessarily to be found in any other period. After further reflection I am inclined to believe that the latter is the correct explanation.

And here I think may be a guide to future investigation. It seems very likely that barometric variations may always be passing through phases which are persistent for several years. And, during the continuance of each phase the abnormal barometric curve will necessarily approach more or less to a certain annual type. In the cases dealt with in my paper that type chanced to be of a symmetrical form, sufficiently remarkable to strike the eye at once. The regularity of its form made it comparatively easy to be dealt with. An irregular type would of course be less easy to recognise and less easy to be dealt with. But it is obvious that if such types do exist and persist for several years in succession, then, by catching the type as the barometric phase comes in and by noting the departures from it each year, in a manner similar to that adopted with the symmetrical type I had to deal with, these departures may serve also in a similar manner as indices of the coming variations. Of course the methods of calculation would have to be purely arbitrary and specially devised for each barometric phase. If barometrical curves would yield to strictly mathematical methods, the problem of season-forecasting could be regarded as in a fair way of being solved. But it has never yet been found possible to resolve them entirely into regular periodical oscillations; and I believe they will always have to be arbitrarily dealt with.

Melbourne, July 21 A. N. Pearson

**Transmission of Sound**

In connection with the subject of mechanical telephones, which has been occupying public attention lately, there is a note by Mr. Miller in a recent number of Nature, regarding certain experiments made in 1878 on the propagation of sound. With reference to this, Prof. Wernhold, of Chemnitz, writes to me, saying that as early as 1870 he had shown that human speech could be transmitted very distinctly through stretched [illegible] threads, and mentions that the results of his researches are published in an article on "The Transmission of Human [illegible] an Iron Wire," in Carl's "Repertorium für [illegible]sik," Band vii, Serie 168. As your corre[illegible]ably like to refer to this, may I ask you to [illegible]er? W. E. Ayrton

[illegible]hibition Road, London, October 12

**[illegible] the Western Islands?**

[illegible] interesting book on "Work [illegible] high value of rabbits in the [illegible] they were then a recent [illegible] that several islands [illegible] upon them—for instance, Kerrera, which seems to point to the same conclusion. It would be interesting to know whether this is really the fact or not? Herbert Ellis

112, Regent Road, Leicester, October 4

## *THE HELL-GATE EXPLOSION*

Probably the largest chemical mechanical experiment ever thought of was successfully performed last week in New York Harbour by the removal of the obstruction known as Hell Gate, or Flood Rock, a considerable-sized island, as stated by the papers, about nine acres in extent, in Long Island Sound. The agent employed for this immense engineering work is a preparation or preparations of nitro-glycerine, and there is no doubt that this is the only explosive compound which could have been used for the purpose on account of the very enormous quantity required and the peculiar nature of the explosion of this substance. All the compounds or preparations of nitro-glycerine produce by explosion what are known as local effects only, as distinguished from gunpowder, the effects of which are much more gradually developed on ignition, but extend, owing to the slower and larger wave of disturbance, to a much greater distance. The legitimate use of nitro-glycerine is for purposes such as this, where a disruptive action is required.

The operations leading up to the final explosion have been some years in progress. They have consisted in forming a system of tunnels at a considerable depth under low-water level in the solid rock, and the charging of these tunnels with dynamite and mixtures known as rackarock, of nitro-glycerine with compressed gun-cotton. Twenty-four galleries were driven through this island, some of them 1200 feet long, and these were intersected by some forty-six others. These tunnels were about 10 feet high and 8 feet wide, and the roof of rock above them varied from 10 to 25 feet in thickness. The quantity of rock to be removed by the explosive was about 275,000 cubic yards, the quantity removed by tunnelling being about 80,000 cubic yards. A good deal of trouble has been occasioned during the course of the mining work by fissures, which have had to be stopped by wooden plugs in most instances. The explosive was charged into holes drilled into the roof and supporting walls and pillars at different angles, with a view to disrupt the strata of rock as much as possible.

The holes to be charged were about 9 feet in length and $2\frac{1}{2}$ inches in diameter. The holes were charged first with the blasting gelatine or rackarock and filled to the ends with a dynamite cartridge, to which the detonator and electric wire were attached. In all fourteen thousand cartridges of a total weight of fourteen tons were employed. Near observers describe the explosion as being accompanied by a dull roar, but with only the slightest shaking of the ground, even at a moderate distance. An immense quantity of water was bodily raised up to heights estimated variously at 150 to 200 feet.

The results, as far as can be ascertained, are very satisfactory, the rock having been very thoroughly broken up, so that it can easily be dredged away.

After the example of an experiment on this scale, carried out without the least accident, perhaps it may occur to those in authority that we have on our own coasts dangerous rocks, not of the extent of Flood Rock, which might with immense advantage be similarly "chemically" removed.

Had gunpowder been the only explosive available, at least five times the quantity by weight of the nitro-glycerine preparations used in this experiment, would have been necessary and the results would not have been by any means so local or perhaps so satisfactory.

After this the engineer may find it to his advantage to cultivate more the acquaintance of the chemist and his products than has been hitherto the case.

## SUBMARINE DISTURBANCE

THE following is an extract from the Meteorological log kept by Capt. R. J. Balderston on board the ship *Belfast* :—

"On December 22, 1884, at about ten minutes to 3 a.m., local ship's time, or 21d. 19h. 6m. Greenwich mean time, the ship *Belfast*, of Liverpool, was shaken by an earthquake which lasted from about 75 to 90 seconds. The vessel at the time was in latitude 34° 34′ north and longitude 19° 19′ west, the island of Madeira bearing true S.E., distant 145 miles.

"The shaking of the ship was accompanied by a loud rumbling noise, which, as heard from the cabin, resembled the sound which would be made by the rolling of large, empty, iron tanks about the decks, but which, as heard from the upper deck and in the open air, was as that of not very distant thunder, and it appeared to fill the whole of the air.

"I did not hear the commencement of the thunderous sound, and cannot say on what compass-bearing of the visible sky it commenced, but it travelled rapidly through the air and towards the S.W.

"The vibration of the vessel and the noise were greatest during the first 50 or 60 seconds; the former then died gradually away and ended in the very faintest tremor, while the latter, as it travelled south-westward through the atmosphere. died out with a low roar as it appeared to sink beyond the horizon.

"The helmsman found the steering-wheel much shaken as he held it, and in the cabins and cook-house, tin ware, crockery ware, and other light articles were rattled about.

"This little earthquake occurred three days prior to the commencement of the earthquake which caused so much loss of life and property in Spain.

"Meteorological Office, October 9"

## THE BOTANICAL GARDENS IN JAVA

DURING the last few years so many useful and important improvements have been made in the botanical gardens at Buitenzorg and Tsi-Bodas that it might not be amiss if the attention of the readers of NATURE were again drawn to these valuable seats of systematic and philosophical research.

On entering the gardens at Buitenzorg the stranger is at once struck with the wealth and luxuriance of the vegetation he sees, the great height of the trees whose trunks and branches are in many cases covered with heavy creepers, the dense copses of the different species of bamboo, the eccentric-looking screw-pines and the handsome palm trees; but the scientific observer is also struck with the care that has been taken to arrange all these many varieties of tropical plant life in, as far as possible, their systematic order, and that each specimen has its scientific, and in many cases its Malay name also, clearly and distinctly printed on a little board by its side.

It is not difficult for any one to find his way about the garden, and in a very short time he can discover the particular family or group of plants which he may desire to study. Many families have probably more representatives in these gardens than in any in the world. The Sapataceæ, for instance, so rarely seen in Europe, are here represented by a great variety of genera and species, and the Palmaceæ, the Rubiaceæ, the Burseraceæ, the Orchidaceæ, and other families have now a large number of rare and interesting representatives.

The herbarium which is attached to the garden contains a large collection of dried plants and seeds collected together from the many expeditions into the little or unknown parts of the archipelago and from other sources. Attached to the herbarium there is a comfortable and convenient little library which contains most of the [impor]tant botanical books and journals.

The laboratory, which, thanks to the energy of Dr. Treub, the director, is now completed, is a large, lofty and, for these climes, particularly cool room, and is well fitted out with reagents and apparatus for carrying on botanical research. The generous invitation which Dr. Treub has issued to naturalists and to which the attention of the readers of NATURE has already been directed has attracted several scientific men of different nationalities, and some excellent research has already been made in this laboratory.

When I arrived in Buitenzorg Dr. Treub was at Tsi-Bodas; so, after spending a few days in study in the gardens, I made the journey across the mountains to pay him a visit. The road from Buitenzorg to Tsi-Bodas crosses the Poenchuk Pass and is full of interest and beauty. On the way the traveller passes quite close to the Talaga Werner, the crater of an extinct volcano which is now filled with water, and forms a most beautiful lake hidden in the dense foliage of the mountain side. The path from the road to the lake is through a virgin wood of fine forest trees, and amongst the undergrowth is found many fine shrubs and plants which are not found in the low-lying country beneath.

The gardens at Tsi-Bodas are situated on the slope of the Gedeh Mountains, at an altitude of 5000 feet, and here I found Dr. Treub at work in the comfortable house which is attached to the gardens.

From this spot a very wide range of vegetation may be studied, from the rich and varied vegetation of the plains to the interesting vegetation of the Gedeh and Geranso peaks, at an elevation of 10,000 feet. In the gardens themselves a very fine collection of Conifers from America, China, Australia, and other parts of the world has been got together, and spaces have been cleared for the growth of the various species of Eucalyptus, Cinchona, and other plants. Year by year the surrounding forest is being encroached upon by these gardens to make room for new importations. I was extremely sorry that I could not prolong my stay at Tsi Bodas, but had to return to Batavia to catch the Molucca boat. I saw, however, enough to convince me of the great importance of these gardens for the advancement of our botanical knowledge and the great opportunities they afford for research into all branches of the science.

I need hardly say that the climate in this region is extremely pleasant and invigorating, and the neighbouring village of Sindanlaya is much resorted to by Europeans and others whose health has suffered on the coast or low-lying districts of the Archipelago. At Buitenzorg the climate is by no means unpleasant or unhealthy, but as it lies a few thousand feet lower than Tsi-Bodas, it is naturally a good deal warmer; but I am assured that several Europeans have worked there for several years without feeling their health the least bit affected.

It is hardly necessary to add that every one who has come over to Java to work in these gardens has been amply repaid for the time spent in the long journey over the sea, for the insight which can be gained here into what tropical botany really is is one which can be gained nowhere else in the world so well, and leaves an impression which is not likely to be forgotten in a lifetime.

Batavia, July SYDNEY J. HICKSON

## ON CERTAIN NEW TERMS OR TERMS USED IN A NEW OR UNUSUAL SENSE IN ELEMENTARY UNIVERSAL GEOMETRY

*Point, Line, Plane, Space, Extension*

A LINE may as usual be understood to mean a right line unless the contrary is stated.

Representable extension will comprise the continua corresponding to the first four terms above written.

understood, the term *a space* is susceptible of a more precise meaning than is usually attributed to it: its *intrinsic* equation is given by Cayley's theorem of squared distances. It is a homaloid or flat of the 3rd as a plane is such of the 2nd, a line of the 1st, and a point of the *zero*th order.

The phrase *space of the 4th order* ought accordingly to be superseded if we would avoid using the same word in two different senses—*i.e.* in a wider and narrower sense. *Extension of the 4th* order is the proper expression to take its place, and so in general we ought to speak of *extension* of any given order $n$, and drop the phrase *space* of $n$-dimensions.

### *Figure, Plasm, Enclosure*

A figure may exist in extension of any order. When pervasively limited by homaloids, simple and closed, I had proposed to give to it the *provisional* name of *plasm*, but Dr. Ingleby has supplied me with the more appropriate, or at least more simple, term, *enclosure*.

On the number and nature of simple regular enclosures in extension of any order, consult a remarkable memoir by Prof. Stringham * of the University of California (formerly of the Johns Hopkins University), in the third volume of the *American Journal of Mathematics*.

### *Homaloid, Flat, Niveau, Absolute Measure of Distance*

*Homaloïd*, the term long ago introduced by the writer of this note, *flat*, suggested by the late lamented Clifford, are now well understood, and need no new explanation; but it is well to bear in mind the *intrinsic equation* which serves to define them *to wit*

A homaloid in *extension of the nth order* is definable by means of an equation of the second order (naturally expressible in the language of determinants), in which $(n+1)$ points are the standards of reference, and the squared distances from these of any other point in the homaloid are the coordinates.

Observe that the squared length is the absolute measure of distance *between* two points. The distances of each *from* the other are not equal but opposite quantities differing in algebraical sign.

A *niveau* is a very convenient term to signify the *homaloid* of the *lowest* order that can be drawn through a given point-group and is always *unique;* the order of the homaloid which is the *niveau* to a group of $n$ points cannot exceed $n-1$.

### *Curves, surfaces*, &c., of the 1st, 2nd, and *n*th *kind*.

A plane (or simple) curve is of the first kind; "a twisted curve," "courbe gauche," or a curve in extension of the 3rd order, of the second kind, and in general a curve in extension of the $n$th order is a curve of the $(n-1)$th kind.

Similarly we may define a simple surface as one of the first kind, and a surface in extension of the $n$th order as one of the $(n-2)$th kind; and so in general a figure of *variety i* † ($i$ being 1 for a curve, 2 for a surface), in extension of the order $n$, is one of the $(n-i)$th kind.‡

* Mr. Stringham, a native of "the bloody land" of Kansas, studied mathematics and fine art under Peirce and Norton, at Harvard, obtained a fellowship at the Johns Hopkins University, and completed his studies under Klein in Leipsic. In his memoir he has given perspective drawings of the bounding solids about a vertex of the regular figures in quaternary extension, such solids being supposed to be previously rotated round the vertex into the same *space*, which of course may be done just as the bounding planes about a vertex of a regular figure in ternary extension may be rotated round that point into the same *plane*.

† A curve may be called a one-dimensional, a surface a two-dimensional, a solid a three-dimensional *continuum* and, and so on. Thus a *solid* is to a space what a *surface* is to a plane and a *curve* to a right line.

‡ The ordinary systems of geometry, whether Euclidian or Non-Euclidian (Ultra-Euclidian would be the more correct term), contemplate figures as contained in homaloids of some order or another; but this limitation has an empirical origin, and is not an essential ingredient of the pure theory of form; for instance, a curve, *i.e.* a *unidimensional continuum*, may, and in general will, be such as cannot be contained in a homaloid of any number of dimensions whatever; it might be said that the order of its *niveau* in such case is infinite; but this would be a mere verbal quibble—the right view being that it is *sans niveau*. The radical distinction therefore is not between the common Euclidian geometry and its generalisation (the so-called Non-Euclidian) but between the Homaloidal and the Anhomaloidal geometries.

### *Curve, Locus, Assembly, Envelop, Environment*

A *curve* is that which is common to a locus of points and an assemblage of tangents; the locus is the *envelop* of the assembly, and the assemblage the *environment* of the locus.

### *Lines and Points*

A line may be used in the double sense of a locus or direction. In the latter signification an Euclidian or objective line is the union of two lines running in contrary directions and an analytical line is a half-line, a "semi-droite," meaning, of course, a half-Euclidian line.

So a point may mean either a position or an infinite assembly of lines (containing or) contained in it; used in the latter sense, it might temporarily be termed a *pencil-point*.

There are half or split points, as there are half or split lines. Thus the infinite extremities of the asymptotes to a hyperbola are half-points, the union of two of them being the correspondent to a single point in any ellipse of which the hyperbola is a perspective image.

### Coordinates, *Homogeneous and Correlated*

Homogeneous systems of coordinates may be distinguished into *absolute* and *proportional*.

In the former the absolute magnitudes of each are material, in the latter their ratios only.

Also into *direct* and *inverse*.

Direct coordinates are measured by given multiples of the distances of a variable point from fixed homaloids; inverse by given multiples of the distances of a variable line, plane, &c., from fixed points.

*Correlated* systems of direct and inverse coordinates are those in which my "universal mixed concomitant" (Clebsch's *connex*) $\xi x + \eta y + \zeta z$ (for greater clearness I confine myself for the moment to a particular diagrammatic case) equalled to zero expresses a line whose inverse coordinates are $\xi, \eta, \zeta$, when these are made constant and a point (pencil-point) whose direct coordinates (when it is regarded as denoting position) are $x, y, z$ when these in their turn are made constant.

If the distances of a point from the sides of the triangle of reference are $l, m, n$, and of a line from the angles of the *same triangle* $\lambda, \mu, \nu$, and if the direct coordinates being $cl, dm, en$, and the inverse ones $\gamma\lambda, \delta\mu, \epsilon\nu$, and the distances of the angles from the sides $p, q, r$—

$$c\gamma p = d\delta q = e\epsilon r.$$

$l, m, n$; $\lambda, \mu, \nu$ are *correlated* systems.

If $l' \; m' \; n' \; p'$; $l, m, n, p$ the direct coordinates of two corresponding points in a homography are connected by the Matrix $M$ and $\lambda' \mu' \nu' \pi'$; $\lambda, \mu, \nu, \pi$ (the inverse coordinates of two corresponding planes of the same homography) by the Matrix $M'$, then if the two systems of coordinates are correlated, $M$ and $M'$ will be *opposite* matrices.*

Of course the like will be true in extension of all orders: thus *ex. gr.* in the case of a plane if for a given homography

$$l' : al + bm + cn$$
$$:: m' : dl + em + fn$$
$$:: n' : gl + hm + kn$$

Then

$$\lambda' : (ek - fh)\lambda + (fg - dk)\mu + (dh - eg)\nu$$
$$:: \mu' : (ch - bk)\lambda + (ak - cg)\mu + (bg - ah)\nu$$
$$:: \nu' : (bf - ce)\lambda + (cd - af)\mu + (ae - bd)\nu$$

* In other words, for two point line, point-volume, &c., schemes homographically related, employing *correlated* systems of *proportional* coordinates, the matrix which serves to express the relation between the direct coordinates of the first scheme and those of the second may be taken the transverse of the matrix which does the same between the inverse coordinates of the second and those of the first. This is an important and as far as I am aware a new *theorem*.

provided that $l, m, n$; $\lambda, \mu, \nu$ are *correlated* systems of coordinates.

*Images: Reciprocals or Polar Reciprocals*

It is very convenient to speak of any function which equated to zero expresses a figure as an *image** of such figure; thus *ex. gr.* $\xi x + \eta y + \zeta z$ may be spoken of as an image of the line $\xi, \eta, \zeta$ and of the point $x, y, z$.

A curve being the concept common to a locus and an assembly (the common ground, so to say, of the existence of each of them), will be capable of being imaged in terms of either direct or inverse coordinates. If the two coordinate systems are supposed to be correlated (as they ought always to be) then any two homogeneous functions which are reciprocal, or, let us say, conjugate to one another (each in common parlance the *polar reciprocal* of the other) will be images—the one of the curve under its aspect as a *locus*, the other of the very same curve under its aspect as an *assemblage*.

*Reduced Perpendicular Distances*

An extremely convenient system of homogeneous coordinates of a point is where each coordinate is the distance from one of the boundaries of the fundamental enclosure divided by the distance of that boundary from the opposite angle. Such coordinates may be termed coordinates of reduced distance or reduced coordinates; they are analytically defined by their sum being unity. If $a, b$ be the two vertices which correspond to the coordinates of reduced distances, the squared distance of any two points, $x, y, z, \ldots$; $x', y', z', \ldots$ in extension of any order is capable of being expressed by the formula $\Sigma(ab)^2(x - x')(y' - y)$, which, as far as I have been able to ascertain, is nowhere stated in the books, except for the case of trilinear coordinates.

*Exchangeable Figures*

Two figures indistinguishable from each other by any of their internal properties, but incapable of occupying the same place (such as the left- and right-hand glove or shoe) have received the very awkward and misleading name of *symmetrical* figures; I propose to call them exchangeable figures, inasmuch as in the nature of things, as they are in themselves (without regard to the limitation of the human faculties), they may be made to pass into each other's places by a semi-revolution about a suitable homaloidal axis.

*The Point-Pair at Infinity, Lines and Planes of Null*

It has been already shown in these columns that the "absolute" in a plane has full right to be called the *point-pair* at infinity, in analogy with the received expression of the *line* at infinity, and those who have considered what has been here stated under the head of *reciprocity* will see good grounds for admitting that the line at infinity ought to be regarded as a complete line, *i.e.* as made up of two analytical "semi-droites."

Every line through either half of the absolute besides the property of being infinitely distant from any point in the finite region may be termed a *line of null*, in the sense that the distance between any two points in such line is zero.

In like manner any plane *touching* the absolute in extension of the 3rd order, besides being infinitely distant from the finite region, is in the same sense a *plane of null;* in it, form is divorced from content, for a figure of any shape being described upon such plane, its content will be *nil*.

*Pluri-duality: Containing and Contained*

In extension of $i$ dimensions each continuum of $\lambda$ dimensions stands in a relation of reciprocity to one of $i - \lambda - 1$ dimensions, the total number of these "[illegible]ities" being $\frac{i+1}{2}$ when $i$ is odd and $\frac{i}{2}$ when $i$ is [illegible] (in the former case the continuum of $\frac{i-1}{2}$ dimensions being its own reciprocal). It is very convenient [illegible] connecting reciprocal geometrical statements to [illegible] the difference between (and to regard as exchangeable and equivalent) the terms *containing* and *contained in* as applied to heterogeneous continua; indeed the ordinary distinctive use of these words suggests an erroneous conception; as *ex. gr.* of a line being *made up* of points or a plane of lines. A point may be said to contain every line or plane which passes through it, and a line every point which lies on it, and every plane [illegible] passes through it: as an example of this extended [illegible]tion the order, rank, and class of a surface may be [illegible] as follows—viz. the order and class as the number of point and plane elements respectively contained in a given line; the rank as the number of its line elements contained in common by any given point and plane [illegible] contain one another.

A plane-section of a surface is the totality of its [illegible] or line-elements contained in a plane and similarly point-section (an enveloping cone), the totality of [illegible] plane- or line-elements contained in a point: hence [illegible] differently the class of any plane-section or the order [illegible] any point-section of a surface is its rank.*

J. J. SYLVESTER

## NOTES

ALL the five French academies will celebrate by a [illegible] the ninetieth anniversary of the foundation of the Institute, [illegible] was established on October 25, 1795, by the Conseil Lég[illegible] and Directoire Executif of the French Republic. The [illegible] organisation is not quite the same as the original, great alterations having been made in 1814, and only partially abolished [illegible] subsequent occasions.

THE death took place last month of General J. J. Baeyer, President of the Central Bureau for European Triangulation [illegible] of the Royal Prussian Geodetic Institute. General Baeyer [illegible] reached the age of ninety-one years. A biography of some [illegible] will be found in the *Astronomische Nachrichten*, No. [illegible]

M. ROBIN, a member of the Paris Academy of Sciences [illegible] the French Senate, died last week. He had devoted his [illegible] to microscopy, and was professor to the School of Medicine.

* When an *image* is given, its *object* is absolutely determined, but not *vice versâ*, since an image may be magnified or diminished at will by the introduction of a constant factor.

* The word *spread*, to signify an unlimited expanse of [illegible] points and so used by Dr. Henrici, is, I am informed, originally [illegible] late Prof. Clifford. In ignorance of this fact, on hearing that He[illegible] been attacked for his use of the word, I stated my belief that it [illegible] been borrowed from my use of it to signify a limited portion of [illegible] equi-spaced points, such as that which is turned to so profitable [illegible] *constructive theory of partitions* in the *American Journal of Math[illegible]*

I did not know at the time that Clifford had used the word, [illegible] Henrici's treatise preceded by several years the publication of [illegible] above referred to. This erroneous oral statement seems to have [illegible] way by some more or less circuitous channel to the columns of the [illegible] *Review* in a notice of a criticism, by Mr. Dodgson, of Dr. Henrici's [illegible]metrical manual in the Scientific Series. Dr. Ferrers (the Master of [illegible] College, Cambridge) was the first to apply a spread to demonstrate [illegible]tuitively a celebrated arithmetical theorem of reciprocity due to [illegible] Mr. Durfee a quarter of a century later led the way to a further and [illegible] pregnant use of the same by showing how to trisect a symmetrical spread bounded by two right lines and a broken line into a regular square [illegible] two quasi-triangular appendages, to which I superadded the [illegible] multisecting it into a succession of angles. Another pupil of mine at the Johns Hopkins University (Mr. Ely) has laid the foundation of a [illegible] theory of partitions, by studying the various modes of decomposing a [illegible] spread of discontinuous points; his memoir on the subject is to be found in a recent volume of the *American Mathematical Journal*.

By means of the trisection method I obtained *inter alia* a new expansion of $(1 - x_{..})(1 - x^2 z) \ldots (1 - x^i z)$, which, on making $z$ unity and [illegible] leads immediately to Euler's celebrated pentagonal power series, and other results of a totally novel kind by the multisection method: so that a spread may justly be regarded as a potent instrument or magical mirror for extending old and bringing to view new truths in the *wonderland* of partition and elliptic-function series.

BY invitation of the Lieutenant-Governor of the Isle of Man Prof. Boyd Dawkins recently visited that island in order to report on its antiquities and the best means of preserving them. The result is given in a short communication to the Lieutenant-Governor, in which Prof. Dawkins indicates the present condition of the various classes of remains. He points out what should be done for their preservation, and advises that the island Legislature should pass an Act similar to the "Ancient Monuments Act" of the "neighbouring islands" of Great Britain and Ireland. The advice given by Prof. Dawkins is sound, and it is creditable to the Lieutenant-Governor that he has shown so much intelligent zeal in the matter. We are glad to note that he intends to follow up his action by introducing a bill into the Council with a view to carrying out Prof. Dawkins's recommendations.

THE last publication of the Japanese Meteorological Observatory which has reached us contains the monthly summaries and monthly means for 1884, and is accompanied by forty-one maps, showing the isobars, isotherms, and prevailing winds. These volumes must demand unusual care on the part of the compiler, for they are printed in Japanese as well as English, and contain a mass of meteorological data of all sorts. We observe that three new stations have been added during the year, one in the north of Yezo, and the other, which should prove a valuable station, is at Fusan, the port of Corea recently opened to Japanese trade. This constant annexation of new territory by the Tokio Meteorological Bureau is to be highly commended.

A RECENT issue of *Cosmos* contains an account of the Jesuit establishments at Zikawei near Shanghai, the meteorological publications of which have frequently been noticed in NATURE. The central establishment of the Jesuits in China is at Funkadoo in Shanghai, but about six miles away at Zikawei (Siccawei) they have a large adjunct, containing their schools, an orphanage, and a college. In the course of its existence the place has been twice sacked, but it was again rebuilt. In 1870 the fathers began with the rudiments of a meteorological observatory, of which Father Dechevrens was the founder, and has been to the present moment the director. Gradually, by purchase and by presentations from various Governments, the observatory became tolerably well equipped, and it is now a magnetic and meteorological station of the first order, making with excellent instruments observations on atmospheric pressure, temperature, humidity, evaporation, rain, winds, solar radiation, terrestrial magnetism in its various manifestations, &c. It issues a monthly *Bulletin* containing the observations, and a *résumé* and discussion of the meteorological events of the month. Thanks of the numerous missionaries scattered over the neighbouring provinces, who correspond with the director, the peculiar atmospheric movements in the China seas are beginning to be understood. Quite recently (as mentioned at the time in NATURE) he has taken advantage, with the assistance of Sir Robert Hart, of the Telegraphs, to establish a regular daily weather service, for the benefit of mariners. The observatory is situated in a vast plain, where the horizon alone stops the view, and where atmospheric movements are not complicated by ranges of hills. A tower 33 metres in height has been erected, and the Beckley anemometer, constructed in 1884 by Munro, of London, is placed on a platform 7 metres higher. The observatory has gone on developing year by year, and there is little doubt that it will soon include in its field astronomical observations. The *Bulletins* are printed at the mission printing-press, which is included in the establishments at Zikawei, the printers being young Chinese. The monthly *Bulletins* form a considerable volume at the end of the year, and that for 1884, which has lately been issued, is the tenth in the series.

WITH regard to the new star in Andromeda Dr. Sophus Tromholt relates the following curious story in a Norwegian journal:—"When the interesting discovery had been made in 1877 that Mars was accompanied by two moons, it was shortly afterwards pointed out that Swift, in 'Gulliver's Travels,' relates that the Liliputian astronomers had discovered the two satellites (Voltaire, too, in a work in which he describes the experiences of two terrestrial beings on Mars, says that they saw the two moons unknown to mundane astronomers, but he has probably borrowed the idea from Swift). A similar remarkable proof that poets may also be prophets in astronomy has just come to light with regard to the new star in Andromeda. In the Hungarian periodical *Losonczi Phönix* for 1851 is a story by Maurus Jókai, the celebrated author, in which he refers to this star. Jókai makes an old Malay (?) relate that the Evil Spirit, Asafiel, revealed to King Saul and his sons the star in the nebula, and predicted that those who could not see it should perish in the impending battle. The Malay also reveals the star to his listeners and describes its position so accurately that there cannot be any doubt of the Andromeda nebula being the one referred to, although it is not named. The story, according to Jókai, rests on a biblical or Jewish legend. On the writer of these lines asking one of the greatest living authorities on biblical research whether the bible contains any reference to the point, he is informed that there is absolutely no such reference in that book, and that it is hardly possible that the nebula is mentioned in any Jewish legend. It is first mentioned by a Persian astronomer of the tenth century, and was first discovered in Europe in 1612. It would be exceedingly interesting to ascertain whether any Jewish tradition has preserved the mention of a star in the Andromeda nebula, as from this might be concluded that the new star is a variable one with a long period. I intend to inquire of Jókai whether his story is founded on any tradition or only an outcome of the author's imagination, but even should the latter be the case the story is a very curious one."

ALGOLOGY is becoming a favourite science with some Russian botanists. After the valuable researches of Dr. Gobi on the algæ of the Gulf of Finland, several memoirs have been published by MM. Reinhardt and Rishavi on those of the Black Sea, and we find now in the last issue of the *Memoirs* of the Novorossian Society of Naturalists (ix. 2) an elaborate paper, by M. Reinhardt, being contributions to the morphology and classification of the Black Sea algæ. The paper is the first of a series. Following Bornet and Thuret's example given in their "Notes Algologiques," the author publishes his observations on separate species, without awaiting the time when he will be enabled to publish a more complete work. In the morphological part of his paper, M. Reinhardt discusses the development of a few Chlorophylleæ, and enters into more details with regard to some of the Cyanophyceæ, and especially the Phæosporeæ (the conjugation of *Ectocarpus siliculosus* and the growth of *Sphacelaria*). As to the Rhodophyceæ, only short remarks, especially as to pores in their external covering, are given. The chief attention has been devoted, however, to the Bacillariaceæ, and the paper contains a good deal of new observations on the structure of gelatinous colonies, the structure of the cell and its protoplasmatic parts, and the auxospores. The systematical part will appear in a next issue. The paper is accompanied by eleven tables engraved in Germany.

THE same volume contains a very interesting paper on the development of Rotifers, by the Director of the Sebastopol Zoological Station, Miss Pereyaslavtseff. This subject has been rather neglected until now, and M. Zaleski's paper on the history of the development of the *Brachionus urceolaris* could not be considered as a complete solution of the question. Miss

Pereyaslavtseff's method differs from most of those hitherto recorded: she does not select one or another phase of development as being the most important, but, placing several Rotifers and Lepadellæ under the object-glass of a microscope, she waited until one of them would lay an egg, and the development taking about three days from the beginning of the segmentation until the issue of the new animal from the egg, she observed it continually throughout the first thirty to thirty-five hours, with only short interruptions of two to three hours in the observation of subsequent phases. This method has of course its inconvenience by preventing sleep for two nights. It cannot be applied also to those Rotifers which live an errant life. These last do not survive confinement, and must be kept in watch-glasses until they lay their eggs, which last are then brought under microscopic investigation. Ten different species were studied in this way, and proved to undergo the same development, so that *Rotifer inflata* has been given as a type of the development of the egg. The stages are all figured in forty-eight drawings on a plate accompanying the memoir.

THE same volume contains, moreover, three papers on geology: one by M. Sintsoff, on Tertiary fossils from Novorossia, being a description of the following new species: *Anodonta unioides*, *Scrobicularia tellinoides*, *Ervilia minuta*, *Neritina pseudo-Grateloupana*, and several others formerly described; it also contains a list of the fauna of the intermediate Ponto-Sarmatian deposits of the region. Another, by M. Miklashevsky, gives some information on the Government of Tchernigoff; and a third, by M. Andrusoff, deals at length with the geology of the Kertch peninsula, and throws some new light on the confused geology of the Crimea. It appears from the author's researches that the Tertiary deposits of the Crimea may be subdivided into the following: (*a*) the true *Congeriæ* deposits (Pontri), consisting of iron-bearing clays, equivalent in West Europe to the deposits of Hidas and Arpad, and of limestones, sandstones, and marls equivalent to the *Dreissena triangularis* deposits of the Vienna basin, the *D. rostriformis* deposits of Ploeshti and the upper Siebenburgen deposits; (*b*) the Ponto-Sarmatian intermediate group of the Kertch limestone, equivalent to the lower Siebenbürgen deposits; (*c*) the Sarmatian group, equivalent to the same of Roumania, Turkey, and Austria-Hungary; and (*d*) the Upper Mediterranean, equivalent to the *Leythakalk*, the *Badner Tegel*, &c. It would result from the above, and from what is known about South Russia and the Crimea, that during the older Miocene period both were a continent. Later on they were invaded by a sea penetrating from the west, and a narrow gulf limited in the south by the Yaiba hills, extended towards the East. During the Sarmatian epoch the subsidence continued, followed soon by an upheaval towards the end of that period, which upheaval led to the formation of narrow, less settled bays, like those we see now on the Kuban, at the place formerly occupied by the Sarmatian Gulf.

*The Garner and Science Recorder's Journal* is the title of a new scientific monthly, edited by Mr. A. Ramsay, and published by W. E. Bowers, Walworth.

A SOCIETY for the Advancement of Science has been formed in Bergen, numbering about a hundred members, the President being Dr. Danielsen.

MR. ARTHUR S. PENNINGTON'S Manual of British Zoophytes, to be published immediately by Messrs. L. Reeve and Co., will include not only the Hydroida but also the Actinozoa and Polyzoa found in Great Britain, Ireland, and the Channel Islands. The same publishers announce an illustrative volume of "Collections and Recollections of Natural History and Sport," by the Rev. G. C. Green.

WE have received the sixteenth annual Report of the N[illegible] and Norwich Naturalists' Society, forming part [illegible] the *Transactions*. Amongst the published papers [illegible] dential address by Mr. Francis Sutton, F.C.S., on the [illegible] tion of soils by means of minute living organisms; [illegible] gentleman also contributes a most valuable paper [illegible] varieties of sugar, natural and artificial; Mr. Horace B[illegible] ward, F.G.S., gives a paper on the earthquake of Ap[illegible] which made itself so severely felt in the counties of N[illegible] Suffolk; Mr. F. D. Power, who visited the Norf[illegible] during the period of the autumnal migration, in his "[illegible] logical Notes from Cley and Blakeney," shows the [illegible] influx of birds, some of which are generally supposed [illegible] the greatest rarity, which takes place on the eastern [illegible] that period; amongst Mr. Power's list of rarities occur[illegible] throated warbler, of which he says he must have [illegible] eighty to one hundred individuals, and the barred an[illegible] warblers. Mr. J. H. Gurney, jun., also contributes [illegible] able facts bearing upon the vexed question of migration [illegible] observance of which the Norfolk coast is so favourably [illegible] Mr. Southwold furnishes his usual review of the herring [illegible] from the ports of Yarmouth and Lowestoft, from [illegible] appears that the enormous number of 505,005,600 [illegible] taken by the fishermen using those two ports; the same [illegible] man also contributes a paper on the white-beaked [illegible] Cetacean which has been procured on several occasions [illegible] east coast. The "Ornithological Notes" of Mr. Hy. S[illegible] F.L.S., are in continuation of a series extending back [illegible] years; and a most interesting memoir of John Scales [illegible] buted by Prof. Newton, forming one of a series of [illegible] naturalists of whom the county of Norfolk has since the [illegible] mencement of the present century produced so many [illegible] examples.

AN experiment has recently been tried at the Invent[illegible] hibition Aquarium by Mr. W. August Carter with a [illegible] discovering how far fish are prone to sleep. After close exa[illegible] tion he found that amongst freshwater fishes the roach [illegible] gudgeon, carp, tench, minnow, and catfish sleep peri[illegible] common with terrestrial animals. The same instinct [illegible] found to actuate marine fish, of which the following [illegible] observed to be equally influenced by somnolence—[illegible] wrasse, conger eel, dory, dogfish, wrasse bass, and all spe[illegible] flat fish. Mr. Carter states that, so far as he can dis[illegible] goldfish, pike, and angler fish never sleep, but rest peri[illegible] Desire for sleep amongst fish varies according to meteor[illegible] conditions. Fish do not necessarily select night-time [illegible] repose.

THE specimens of fish collected for the International [illegible] logical Museum, which is being formed by the Nationa[illegible] Culture Association, now number about 500. They [illegible] many rare fish as well as those of extraordinary grow[illegible] formation. Many of the specimens are the finest to be se[illegible] London, having been specially caught for the Associa[illegible] qualified ichthyologists and agents. The work of setting [illegible] fish out in glass jars is now being commenced, and it [illegible] to be able to exhibit them to the public shortly.

WE have received the third and concluding part [illegible] Hann's paper before the Berlin Academy of Sciences [illegible] temperature of the Austrian Alps. The tables contain [illegible] and yearly averages of temperature for 382 sta[illegible] Austrian Alps and the neighbourhood reduced [illegible] (24-hour) average, and to a thirty-year period (1851 [illegible] the stations 277 were below 1000 metres, 88 lay be[illegible] and 2000, while 17 were over 2000 metres in height [illegible] obtained at all these stations over a period of years [illegible] worked up and arranged. The present part con[illegible] pages, so that the whole paper would make a considerable volume dealing with temperatures in the Alpine regions of Austria.

M. D'ABBADIE begs us to state that the earth-tremors observed in his apparatus (NATURE, vol. xxxii. p. 568) about two miles north of the Spanish frontier coincided with the many earthquakes in the south of Spain. There were no such phenomena in Egypt.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus* ♂) from India, presented by Mr. L. C. Phillips; a Ring-tailed Coati (*Nasua rufa* ♂) from South America, presented by Lieut. W. F. Tunnard, R.N.; a Black Wallaby (*Halmaturus ualabatus* ♂) from South Australia, presented by Mr. R. E. Wootton Isaacson; a Javan Cat (*Felis javanensis*) from Java, presented by Capt. T. H. Franks; a Puma (*Felis concolor* ♂) from South America, presented by M. Rodolfo Aranz; two West Indian Rails (*Aramides cayennensis*) from Brazil, presented by Mr. J. C. Fraser; a Levaillant's Amazon (*Chrysotis levaillanti*) from Mexico, presented by Mr. H. D. Astley, F.Z.S.; a Silver Pheasant (*Euplocamus nycthemerus*) from China, presented by Mrs. James; three Robben Island Snakes (*Coronella phocarum*), a Hoary Snake (*Coronella cana*), a —— Elaps (*Elaps hygiæ*), a Reddish Pentonyx (*Pelomedusa subrufa*) from South Africa, seven Geometrical Tortoises (*Testudo geometrica*) from the Orange River, South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, deposited; a Blue and Yellow Macaw (*Ara ararauna*) from Trinidad, received in exchange; eight Summer Ducks (*Ex sponsa*, 4 ♂ 4 ♀) from North America, purchased; a Bennett's Wallaby (*Halmaturus bennetti* ♀), born in the Gardens.

## *ASTRONOMICAL PHENOMENA FOR THE WEEK*, 1885, *OCTOBER* 18–24

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on October* 18

Sun rises, 6h. 31m.; souths, 11h. 45m. 9·9s.; sets, 16h. 59m.; decl. on meridian, 9° 47′ S.: Sidereal Time at Sunset, 18h. 48m.

Moon (two days after First Quarter) rises, 14h. 51m.; souths, 20h. 0m.; sets, 1h. 17m.*; decl. on meridian, 10° 27′ S.

| Planet | Rises h. m. | Souths h. m. | Sets h. m. | Decl. on meridian ° ′ |
|---|---|---|---|---|
| Mercury | 6 37 | 11 51 | 17 5 | 9 43 S. |
| Venus | 10 37 | 14 30 | 18 23 | 23 26 S. |
| Mars | 0 6 | 7 38 | 15 10 | 16 38 N. |
| Jupiter | 3 35 | 9 54 | 16 13 | 3 5 N. |
| Saturn | 20 41* | 4 49 | 12 57 | 22 17 N. |

* Indicates that the rising is that of the preceding and the setting that of the following day.

*Phenomena of Jupiter's Satellites*

| Oct. | h. m. | | Oct. | h. m. | |
|---|---|---|---|---|---|
| 21 | 4 32 | I. tr. ing. | 22 | 4 10 | I. occ. reap. |

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

| Oct. | h. | |
|---|---|---|
| 20 | 0 | Saturn at least distance from the Sun. |
| 20 | 13 | Saturn stationary. |

## *GEOGRAPHICAL NOTES*

THE work done by Lieut. Wissmann in his exploration of the Kassai River, the great southern tributary of the Congo, is second in importance only to the discovery of the Congo itself. It will seriously modify the conjectural geography of that part of Africa. [illegible] and the river to be of immense volume, and navigable [illegible] with the Lulua. He found the Sankuru a[illegible] be one river, which, instead of flowing [illegible], turns westwards, and joins the Kassai. As it approaches the Congo Kassai receives the great Koango, and enters the main river by the Kwamouth, after receiving the water of Lake Leopold. Thus the river which on Stanley's last map joins the Congo west of Stanley Falls cannot be the Lubilash, and, moreover, must be of no great length. This discovery of Lieut. Wissmann, along with that of the Mobangi by Mr. Grenfell, greatly increases the navigable waterway of the Congo system.

THE September number of *Petermann's Mittheilungen* has for its principal article the first part of an account of Paulitschke and Hardegger's journey to Harar, by Dr. Paulitschke. It is accompanied by a map of the districts traversed. The present instalment describes the circumstances under which the journey was undertaken, the preparations at Zeila, where the English consul was able to put the travellers in friendly communication with Abu Bakr, the Governor of Zeila, who gave them the most important help, and the details of the journey as far as Bussa, on the frontier of the Northern Gallas country. Dr. Schinz asks the question whether Namaqua-Land or Nama-Land is correct, and decides in favour of the latter. "Namaqua" is a Dutch corruption; the term "Nama" is applied to Hottentots in general, without any distinction of sex; "namaqua" is properly "namagu" or "namaga," the nominative and dative plural of "nama"; "qua" is therefore doubly wrong as a suffix, and Namaland is the proper term. M. Rabot writes on the Stor Börgefjeld in Nordland in Norway, and the usual literary and geographical news brings the number to a conclusion.

THE last number (Band xxviii. No. 29) of the *Mittheilungen* of the Geographical Society of Vienna contains a paper on the ethnic members of the western Somali and north-eastern Galla tribes, by Dr. Paulitschke, accompanied by a map; six letters from Dr. Lenz on his Congo expedition, and the first part of a paper by Herr Jülg on the erosive action of the sea on coasts; the bibliography of Africa for the last half year, and the usual notices of geographical works conclude the number.

M. BRAN DE SAINT POL-LIAS, who was sent on a scientific mission to Tonquin and Java, returned to France towards the close of September. He brought back with him numerous specimens of the flora and fauna of the districts through which he travelled.

THE chief geographical societies in Germany have resolved to erect a monument to the late Dr. Nachtigal on Cape Palmas, where he lies buried. It is intended to have it so large that it will serve as a landmark to seamen.

THE Godeffroy Museum at Hamburg, illustrative of the natural history of the South Sea Islands, has been sold to the Ethnographical Museum of Leipsic.

## *THE GREAT OCEAN BASINS*[1]

### I.

THE ancients, down to the time of Aristotle—and most of them for a long time afterwards—regarded the earth as a great plain surrounded on all sides by the mighty, deep, gently-flowing stream of the ocean.

In the geography of the Homeric age there was not supposed to be any communication between the Mediterranean and this all-encircling ocean river. When, in consequence of the excursions of the Phœnicians, the communication through the Pillars of Hercules became known, ideas respecting the outer sea gradually changed. At first, curiously enough, the Atlantic Ocean was regarded as muddy, shallow, and little agitated by the winds—a belief apparently associated with the supposed subsidence of the legendary island of Atlantis. The world, as known to the ancients down to about 300 years before Christ, is represented in this map of Hecatæus.

There seems to be no doubt that the spherical form of the earth was known to some philosophers even before the time of Aristotle—the proof that the earth is a sphere being indeed easy to minds that had received a mathematical training—but these have been few in all ages, and an idea so directly opposed to the apparent evidence of the senses could only be expected to win its way with difficulty. Indeed, at the present day the majority of even educated people are unable to give any reason for their belief that the earth is a sphere, other than that navigators are now in the habit of sailing around it.

[1] Lecture delivered at the Aberdeen meeting of the British Association by Mr. John Murray, Director of the *Challenger* Reports.

However, we find that Erathosthenes, Posidonius, and other learned Greeks, who flourished between one and two centuries before our era, were in possession of ideas concerning the figure and position of the terrestrial globe which do not differ materially from those of the modern geographer. They had considerable knowledge of the great wide sea, a clear perception of the diurnal recurrence of the tides, of their monthly cycles of variation, and correctly ascribed these changes to the influence of the moon. They speculated on the circumnavigation of the globe, and thus anticipated by many centuries the project of Columbus of sailing direct from Spain to the Indies.

During the century immediately preceding the Christian era, and during the dark and middle ages, there was a large acquisition of information with respect to the superficial extent of the ocean. But, when we look back on the history of knowledge concerning our planet, there is to be found no parallel to the impression produced in men's minds and conceptions by the discovery of America, and the circumnavigation of the world, a few years later, by Magellan and Drake. The influence of these events and the great ideas associated with them, can be traced throughout the literature of the Elizabethan period; Shakespeare appears to have had the mental picture of the great, solid, floating globe continually before him. His spirit seemed

> ". . . . blown with restless violence round about
> The pendant world."

To the great mass of people the circumnavigation of the globe was the practical demonstration that the earth was swung in space, supported alone by some unseen power; it was the conclusive proof of its globular form—a fact which must be regarded as the fundamental principle of all scientific geography.

The rage for geographical exploration which set in after the discovery of America brought the phenomena of the ocean into greater prominence, but the science of the sea can hardly be said to have commenced till the seventeenth century, when Hooke and Boyle undertook their experiments as to the depth of the sea and the composition of ocean water; and several naturalists gave descriptions of the animals and plants inhabiting the shallow waters surrounding the land. During the eighteenth century there was again a large acquisition of knowledge concerning the ocean, for the navigator was busy with the study of the winds, currents, and tides; while the two Rosses with other explorers and scientific men made most praiseworthy endeavours to investigate the greater depths of the sea during the first half of the present century.

The vast abysmal regions of the great ocean basins, however, lay all scientifically unexplored, when about twenty years ago their systematic examination was undertaken by expeditions sent forth by our own country and by the Governments of the United States, Germany, Italy, France, and Norway.

It is not easy to estimate the relative importance of the events of one's own time, yet in all probability the historians of the reign of Victoria will point to the recent discoveries in the great oceans as the most important events of the century with respect to the acquisition of natural knowledge, as among the most brilliant conquests of man in his struggle with nature, and doubtless they will be able to trace the effect of these discoveries on the literature and on the philosophic conceptions of our age. A mantle of mystery and ignorance has been cleared away from the eleven-sixteenths of the earth's surface covered by the ocean, and in its place we have much definite and accurate knowledge of the depths of the sea. The last of the great outlines showing the surface features of our globe have been boldly sketched; the foundations of a more complete and scientific physiography of the earth's surface have been firmly laid down.

This evening we will endeavour to pass in review some of the chief phenomena of the great ocean basins, and attempt to bring before you some of the more important results arrived at by the many distinguished men who have been engaged in oceanographical researches during recent years.

If it be remembered that the greatest depth of the ocean is only about five miles, and that the height of the highest mountain is likewise about five miles above the level of the sea, while the globe itself has a diameter of 8000 miles, the comparative insignificance of all the surface inequalities of the earth is at once forced on our attention. A circle 66 feet in diameter having on its surface a depression of one inch; or a globe one foot in diameter, with a groove on its surface one-sixtieth of an inch in depth, would represent on a true scale the greatest inequality, of mountain height and ocean deep, on the surface of the earth. Misconceptions often arise, and erroneous conclusions are fre- quently arrived at when these proportions are not rigidly borne in mind. But, unimportant as these surface features may appear when viewed with reference to the diameter of the earth, or the superficial area of an ocean several thousand miles in extent, still to the geologist and physical geographer the elevations and depressions, foldings and dislocations, vertical and lateral, which form these inequalities are truly gigantic, immense, po... and the more they are studied the more do they appear the result of changes taking place in a very definite and ... manner in the course of the earth's developmental history

Allow me to direct your attention to the maps represen... hemispheres of the earth drawn in equal surface p... The continental land of the world is coloured black, the ... mal regions are coloured red, and between these two there ... border or transitional area which is uncoloured.

You will observe that the dark-coloured masses of continental land are, at some one point, more or less closely connected ... similar masses; there is usually a place where adjacent ... are not separated by oceans of very great depth. A m... might almost journey from any one point in these regions ... other without once losing sight of land. If an exception ... be made to this statement it is in the case of New Zealand ... the Antarctic Continent, for the *Challenger's* dredgings ... brought up masses of schist, gneiss, granite, sandstone, and com- pact limestone along the borders of the ice-barrier, show... all doubt that there is a mass of continental land at the pole, but, since it is buried beneath perpetual snow, its ... extent is a matter of conjecture.

The surfaces of the continents are everywhere cut into ... gorge, mountain and valley, and are continually under... process of disintegration. Water, frost, ice, sudden cha... temperature, are ever tearing the solid rocks to pieces, ... transporting the fragments down to the ocean, or carrying ... the solid earth in solution; the bulk of this material is ... in the areas bordering the continents—the uncoloured ... the maps—there to form rocks which may once again ... dry land. Sooner or later the whole of the continents ... in this way be reduced below the level of the waves, we... other forces at work producing elevation. Such forces are, and they are probably more potent than the disin... and transporting forces, since there are many reasons ... lieving that there is now more dry land than at any other ... of the earth's history.

The continents have an average height of about ... above the level of the sea; they may be regarded as ... plateaus occupying five-sixteenths of the earth's surface

The abysmal regions of the earth, represented by the re... on the maps, occupy eight-sixteenths, or one-half of the ... surface, and have an average depth of three miles bene... surface of the waves. The greatest depths in the Pacific ... the south and east of Japan, where there are abysses ... five miles; and in the Atlantic the greatest depth is to the ... of the Virgin Islands, where there is a depression of a ... over four miles.

From all we yet know of these abysmal areas they have ... diversity of peak, gorge, mountain, and valley compar... those which are met with on land; they are fundamental... of deposition. It is true that the close soundings of t... engineers appear to show that in some cases there may ... cliffs in the shallower depths of the ocean in volcanic areas ... the general aspect of the abysmal regions must be that ... undulating plains, interrupted here and there by huge ... cones, with slopes at a very low angle. When these ... above the surface they form volcanic oceanic islands ... they rise nearly to the surface they are, in the tropics ... capped by coral atolls; but many of them are far bene... waves and are covered by a white mantle of carbonate of ... the dead shells and skeletons of pelagic and deep-sea orga...

The land of the oceanic islands is of small extent and ... widely in the nature of the rocks, as well as in the char... the terrestrial and marine fauna and flora, from the con... and continental islands. There has not been found ... abysmal areas any land made up of gneisses, schists, san... or compact limestones; nor have fragments of these sedi... formations been found in the erupted rocks of the ... islands, though they are frequent in the volcanic erupt... the continental areas.

We may, indeed, compare the oceanic islands to the fre... salt water lakes scattered over the surface of the contine...

cut off from direct communication with the ocean. These lakes differ as much from the waters of the ocean as do the oceanic islands from the land of the continents.

The surface of the earth may then be divided into three great regions—the abysmal area, occupying, so to speak, the bottom of the basins, covering one-half of the earth's surface; a border region occupying, so to speak, the sides of the basins, covering three-sixteenths of the earth's surface; and lastly, the continents which cover five-sixteenths of the earth's surface. The average height of the elevated plateaux of the continents above the submerged plains forming the abyssmal regions is fully three miles.

When we pass to a consideration of the water of the ocean, which fills these great hollows of the earth, it is essential to take account of the superincumbent atmospheric ocean, which everywhere rests on its surface, for the composition of the ocean water, the currents, the distribution of salinity, density, temperature, and even that of deep-sea deposits, are largely determined by the movements of the atmosphere.

One of the most important parts played by the ocean in the economy of the globe is to bring about a more equable distribution of temperature by the winds which blow from it over the land and by means of the oceanic currents that are originated and maintained by the winds.

From the smallness of the *daily* variation of the temperature of the surface of the sea, which are shown by the *Challenger* observations, as discussed by Mr. Buchan, not to exceed 1° F., as compared with the large daily variation on land, there result directly the land and sea breezes with all their beneficial consequences. Similarly from the small *yearly* variation of the temperature of the sea, as compared with the very large variation of the temperature of the land surfaces of the globe, result those great annual changes of the prevailing winds—the most important of which, with respect to widespread climatic effects, is the summer monsoon of the Europeo-Asiatic continent.

But the most important, as well as the most direct, effect of the unequal distribution of temperature over the surfaces of the oceans and continents, is an unequal distribution of atmospheric pressure varying more or less with season. On the one hand, in a particular season we see a portion of the earth's surface with atmospheric pressure much less than in surrounding regions, and as long as the low pressure is maintained the winds from the regions all around continue to blow inwards upon it, bearing with them the temperatures and humidities of the regions from which they have come. On the other hand there are other parts of the earth's surface with atmospheric pressure much higher than in adjoining regions, and, as this state of things continues with little variation throughout the year, the winds blow out in all directions towards surrounding regions. Of this two illustrations may be given.

During winter months atmospheric pressure is much less in the North Atlantic about Iceland than it is all round, and towards this area of low pressure the winds from the surrounding continents blow vorticosely, thus determining the winter climates of the more important countries of the world. Over Canada and the United States the winds are north and north-westerly, by which the rigours of winter are intensified; but in Western Europe the prevailing winds are south-westerly, and, as these winds bring with them the warmth and moisture of the Atlantic, the winter climates of Western Europe contrast strongly, latitude for latitude, with those of the eastern states of America.

Again, pressure is higher in the Atlantic between the north of Africa and America than it is all round, and out of this anticyclonic area of high pressure observations show that the winds blow in all directions towards surrounding regions where pressure is less. To the westward of North Africa the prevailing winds are northerly and north-westerly, but on the south side of his anticyclonic region the winds are easterly, and on the west the winds are southerly.

Owing to these very different winds, and the oceanic currents to which they give rise, the temperature of the sea is much higher off the coasts of Florida than it is off the coasts of Africa in the same latitudes. The effect of these differences is recognisable in the distribution of marine life and coral reefs, and, consequently, of the deposits at the bottom of the sea.

Since over this anticyclonic area, and similar ones in the South Atlantic, North Pacific, and in a less marked degree in the South Pacific, atmospheric pressure remains high throughout the year, notwithstanding the outflow of wind all around from them, it follows that aerial upper currents must flow towards these high pressure regions accompanied by a slow downward movement of the air through their central portions. Now, as observations show that in such circumstances the sky is clear, the air dry, the rainfall small, and the evaporation large, it follows that over these parts of the great oceans, where atmospheric pressure is higher than all around, the rainfall is very far from being sufficient in amount to make good the loss arising from evaporation—a consideration which has important bearings on the difficult question of oceanic circulation.

As in these anticyclonic regions in the great oceans there is opened up a direct communication between the upper regions of the atmosphere and the surface of the sea, by means of the descending aërial currents, it is interesting to ask whether this fact may not have some connection with the volcanic and cosmic dust found in the same regions in the deep-sea deposits; especially is this interesting in connection with recent speculations as to the presence of these substances in the higher regions of the atmosphere.

In thus indicating the positions of the high-pressure areas, and of the winds that blow out from and around them over the great oceans, we have at the same time traced the courses of the great oceanic currents and the positions of the Sargasso seas, for the winds everywhere determine and control the movements of the surface waters.

The moisture taken up from the sea surface by the winds—leaving the water salter than before—is borne to the land and condensed on the mountain-slopes. Eventually this water gathers off the land, passes by rivulet, stream, and river down again to the ocean, bearing along with it a burden of earthy matters in solution. In this manner the ocean has most probably become salt in the course of ages. The water of the ocean now contains, it is almost certain, a portion of every element in solution. Many of these are present in exceedingly minute traces. They are detected either in the sea water or the evaporated-down residue by spectrum analysis; in the copper of ships' bottoms, which have withdrawn them by chemical decomposition; or, again, in the ashes of sea-weeds and marine animals, which, during life, exert a selective influence upon the surrounding water.

(A diagram was exhibited showing the average composition of sea salt.) The individual salts present in sea water are, of course, constantly interchanging their metals and acid radicals, so that it is impossible to say authoritatively what is the precise amount of the respective chlorides and sulphates of sodium, potassium, calcium, and magnesium actually present. But it has been shown by hundreds of laborious and most delicate experiments that the actual ratio of acids and bases in sea salts—that is, the ratio of the constituents of sea salts—*is constant* in waters from all depths, with one very significant exception—that of lime—which is present in slightly greater proportion in deep water.

The total amount of dissolved salts in the ocean would, it is calculated, if extracted, form a pavement 170 feet thick over the entire sea-bed, and of this amount 1¼ inches would be composed of pure carbon, chiefly present as carbonic acid in the carbonates.

On account of the constancy in its composition the determination of any one of the constituents of sea salt—chlorine, for instance—gives the datum for calculating the salinity—that is, the proportion of total salts to the water in which they are dissolved; though determinations of this nature are more conveniently made by observations of density by means of the hydrometer. (A map was exhibited on which Mr. Buchanan has shown the results of his laborious investigations in this direction.) An examination of this shows that the surface water of the ocean is freshest—that is, contains the least salt—at the poles and in the equatorial belt of calms. In the east of the Indian Ocean a change of the monsoons brings about a great change in the salinity of the surface water. The centres of the great systems of oceanic currents produced by the trade winds are the areas of highest salinity in the open ocean; yet here the water is not so salt as in some enclosed seas situated in areas of great evaporation, as the Mediterranean, and especially the Red Sea and Persian Gulf, where the saltest water is found and where a regular circulation is kept up by the outward flow of the denser water. The salinity of the deeper waters is considerably below the average at the surface in the open ocean, especially in the Atlantic.

In the equatorial regions the surface water of the ocean has occasionally a temperature of 85° or 86° F., and the normal temperature in tropical and sub-tropical regions ranges from 60° to 80°. This warm water is, however, a relatively thin stratum on the surface, the great mass of the ocean consisting of cold water—water of 45°, 40°, and of even a much lower temperature. At a little over half a mile of depth in the tropics the water has a temperature of 40°, and at the bottom it is still colder—ice-cold indeed. The ooze which is dredged from the bottom beneath the burning sun of the equator is so cold that the hand cannot be held in it for any time without great discomfort.

In the open ocean the temperature usually decreases with the depth, the coldest water being found at the bottom; but sometimes there are limited areas where the temperature remains uniform for a mile or half a mile above the bottom. This has been shown to depend on the existence of barriers to free circulation, which exist on the floor of the ocean, and cause in a measure a resemblance to the conditions which are so marked in many partially enclosed seas, shut off by submarine barriers from general oceanic circulation, where the temperature is uniform, it may be, from a few fathoms below the surface to the bottom—for instance, in the Mediterranean and Seas of the Malayan Archipelago.

The low temperature of deep ocean water was acquired at the surface in high latitudes, chiefly in the high latitudes of the southern hemisphere. The salt warm water of the tropical regions, which is driven in relatively rapid currents along the eastern shores of South America, Africa, and Australia by the action of the prevailing winds, on reaching a southern latitude of 50° or 55° sinks on being cooled, and spreads over the floor of the ocean. A similar circulation takes place in the northern hemisphere, though modified in many ways by the peculiar configuration of the land: for instance, it is almost certain that the cold water at a temperature of 30° F., which occupies the deeper part of the Norwegian Sea beyond the Wyville-Thomson Ridge, is the dense surface water of the Atlantic, which becomes cold and sinks as it passes northward in the extension of the Gulf Stream. Again, the relatively low temperature found on the eastern coasts of Africa and America seems largely due to the cold deep water which is drawn up to supply the place of the warm surface water driven forward by the trade winds.

While surface currents, both warm and cold, have at times considerable velocities, there is no evidence that rapid currents exist anywhere in the great deeps, on the contrary, the movements must be extremely slow and massive in character; the only exception seems to be on the crests of some ridges at moderate depths between volcanic islands or other similarly situated places.

Through the constant circulation in the ocean the gases of the atmosphere, which are everywhere absorbed at the surface of the sea according to the known laws of gas absorption, are borne down and thus enable myriads of living organisms to carry on their existence at all depths. The nitrogen remains at all times and places nearly constant, but frequently the proportion of oxygen is much reduced in deep water, owing to the processes of oxidation and respiration which are there going on.

The absorbed carbonic acid plays a most important and intricate *rôle* in the economy of the ocean, owing to its tendency to reduce normal carbonate of lime and magnesia to solution in the form of bicarbonate; and to the rapid interchanges to which it is subject in consequence of vital processes. It probably receives large additions from the bottom of the ocean, as an after-product of volcanic eruptions, and through the respiration of animals.

It is often supposed that hydrochemical actions go on with much greater activity in the deep sea where there may be a pressure of four or five tons on the square inch, but, while it would be convenient to assume it, there is no sufficient evidence that [illegible] is the case. The disintegrations, decompositions, and [illegible]sitions which take place in the deposits are all similar [illegible] which take place in shallow water or on land, and any [illegible] peculiarities occurring in inorganic or organic substances [illegible] depths are probably due chiefly to the low temperature, [illegible] perfect stillness, and the absence of light: for, although it [illegible] admitted that some rays descend to much greater depths in [illegible] sea than is usually supposed, yet we must at present believe that none of them reach the greatest depths. The absorbed gases are probably but little affected by the great pressure of the superincumbent water, for in [illegible] it should be remembered that water is but [illegible], any substance which will sink to the bottom [illegible] will in time sink to the bottom of the d[illegible]

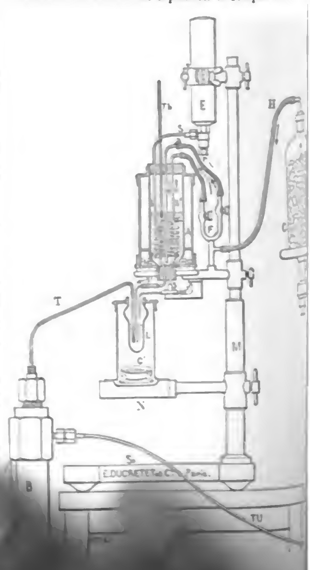
for all substances which are more compressible than [illegible] itself. The compressibility of water cannot, however [illegible] neglected in oceanographical questions. In very great [illegible] the lower layers are considerably compressed; for instance, [illegible] an ocean five miles deep, were the action of gravity [illegible] to cease, the water would rise about 500 feet above [illegible] level from expansion, a height sufficient to submerge [illegible] the habitable land of the globe.

It remains to mention the investigations, which have [illegible] been made, as to the change of level of the ocean, owing [illegible] attraction of the masses of continental or other land—[illegible] instance, as that of the Himalayas for the water of the [illegible] the south, by which the level of the Southern Indian [illegible] lowered some hundred feet; the bearing of this on the [illegible] elevation or submergence of land along coast-lines [illegible] for the level of the sea, to which we refer all [illegible] depths, cannot be regarded as much more stable than [illegible] land itself.

(*To be continued.*)

## *NEW PROCESS OF LIQUEFYING OXY[illegible]*

LIQUID ethylene, the preparation and use of which [illegible] already explained, shows, at its boiling point [illegible] pressure of the atmosphere, a temperature of at least [illegible] only some 10° from the critical temperature of oxygen [illegible] It is understood how in the expansion of compressed [illegible]




[illegible]

egulating the expansion so as to maintain a certain pressure in the tube, the oxygen is seen for some time completely liquefied.

When by means of the air-pump the evaporation of liquid ethylene is accelerated, as was done by Faraday with protoxide of nitrogen and carbonic acid, its temperature is reduced much below the critical point of oxygen.

With a view to avoiding the inconveniences and complications involved in the necessity of working *in vacuo*, I indicated liquid *formène*, which with the greatest ease achieves the liquefaction of oxygen and nitrogen. Notwithstanding these advantages, in consequence of the perfection to which I have recently brought the preparation and management of ethylene, it has seemed to me that this substance should be preferred to formene, and so, by means of boiling ethylene in open vessels, I have succeeded in obtaining a temperature sufficiently low for the complete liquefaction of oxygen.

The preparation of ethylene by means of sulphuric acid and alcohol is frequently impeded by the frothing of the material, terminating the experiment before the gas has been completely liberated. The admixture of sand, recommended by Wöhler, does not always serve to counteract this frothing, but I have found the addition of a small quantity of vaseline efficacious in this respect.

The material I work with consists of 400 grammes of alcohol, 2000 grammes of sulphuric acid, and 15 to 20 grammes of vaseline. This is warmed in a glass globe, of 5 or 6 litres capacity, over a burner in the usual way. The gas is washed in two large flasks of caustic soda, and then collected in a water gas-holder. By means of a mercury pump the ethylene is dried by passing through a flask of sulphuric acid and condensed in steel bottles having a screw tap.

Fig. 1 represents the apparatus I made use of to liquefy oxygen by the rapid evaporation of ethylene by means of a current of air or of refrigerated hydrogen. The liquid ethylene is inclosed in the bottle E, which is fixed to a vertical support, with its mouth directed downwards, and is in communication with a copper worm, S S, of 3 mm. to 4 mm. in diameter, closed at its lower extremity by a screw cock, r'. After the worm has been cooled to – 70° by means of chloride of methylene in the manner I shall explain further on, the ethylene there accumulating possesses at this temperature but a weak tension, and it may therefore be run without sensible loss into the test-tube, L, when the cock, r', is opened. This new arrangement I have adopted for ethylene and formene allows the liquefied gas to be cooled as well as though the whole reservoir containing it were of the same temperature as the worm.

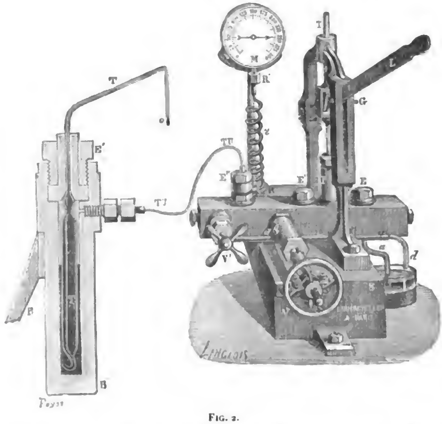



FIG. 2.

The glass test-tube L is arranged in a vessel containing, air dried by means of pumice and sulphuric G', and in this way hoar-frost is prevented from being deposited on the refrigerated sides.

When the ethylene has been received in the test-tube L, its evaporation is accelerated by passing through it a current of air, or, still better, of hydrogen dried by its passage in the vessel C, containing chloride of calcium, and cooled in the worm S'.

The two worms in which the air and the ethylene circulate are plunged into chloride of methylene which is rapidly evaporated by means of dry and cool air, and in this way a temperature of – 70° is obtained.

Fig. 2 shows the arrangement of the oxygen apparatus and compression pump. When the tube To is plunged into the [illegible] the evaporation of the latter is accelerated by gently [illegible] cock F, and blowing on to it the air or hydrogen [illegible] worm S'.

[illegible] then brought into action, and the oxygen re-[illegible]less, transparent liquid, separated from the [illegible] a perfectly sharp meniscus.

[illegible]gen thermometer, the construction of which I shall shortly explain, I have measured the temperature of the ethylene, which in one of my experiments was found to be – 123° C. By dint of certain modifications effected in the apparatus I am in hopes of achieving a still lower temperature.

Altogether, I have proved that by quickening the evaporation of the ethylene by means of a current of air or hydrogen cooled to a low degree, its temperature is lowered much under that of the critical point of oxygen, and that in such a medium the oxygen liquefies most easily.[1]

This experiment is so easy of accomplishment, that the practice of it may be commenced at once in laboratories, and be repeated in public lectures.

The apparatus I have described has been constructed with great care by M. Ducretet, and I have to thank M. Jamin for kindly permitting me to perform the experiments in the Physical Laboratory of the Sorbonne.

[1] M. E. Sainte-Claire Deville, engineer to the Gas Company of Paris, and son of my illustrious master, has now for some time, by my advice, been studying the problem of lowering the temperature by means of the rapid evaporation of chloride of methylene, and has established that, by sufficiently cooling the injected air, temperatures varying from –23° C., to –72° C may be maintained nearly constant for several hours.

## NOTES FROM THE OTAGO UNIVERSITY MUSEUM

### V. *On an "Index-Collection" for small Zoological Museums in the Form of a Genealogical Tree of the Animal Kingdom*

EVEN in the smallest museums it is for many reasons difficult, and often impossible, to arrange the representatives of the various groups of animals in such a way as to bring out clearly their mutual relations. Hence arises the need of an "index-collection" in which each group is represented by one or more specimens so arranged as to indicate as accurately and clearly as possible the affinities of the groups they typify. The form which naturally suggests itself as the most suitable for a small type-collection of the kind indicated is that of a solid phylogenetic diagram or "genealogical tree."

An excellent form of "diagram in three dimensions" for lecture purposes has been devised by Haddon; the model I have recently had constructed appears to me to be more suitable for permanent use in a museum.[1]

It consists of a vertical wooden rod about 3 feet 6 inches in height, representing the main line of descent from Protozoa to Vertebrata; from this spring, at various levels, branches representing types which lie off the direct line; these have in most cases an upward direction, but are directed downwards from their point of origin in the case of degenerate groups. At appropriate points on this framework are placed either actual specimens or models of one or more examples of each group.

As the Vertebrata inevitably take up the largest share of space in a museum as well as of public attention, each of the classes of that group is represented on the model, while in the case of Invertebrata one or two examples only are given to each type or sub-kingdom.

For each group—type or class, as the case may be—a label is provided, giving (*a*) the name of the group, (*b*) the name of the specimen or model serving as an example of it, and (*c*) the place in the Museum where representatives of the group are to be found.

A more correct mode of construction for a model of this kind would be to make the branches of such a length as to bring the ends of all of them, and consequently the specimens they support, to one level; advance of organisation would thus be indicated, not by height above the ground, but by distance from a centre. But such a model would be far less convenient than the form I have adopted.

### VI. *On the Size and the External Sexual Characters of the New Zealand Octopus* (*O. maorum*, Hutton)

In his work on the octopus,[2] as well as in his more recent pamphlet, "Sea-Monsters Unmasked,"[3] Mr. Henry Lee states that the largest British specimen he had examined had arms 2½ feet long; that examples with arms of about 4½ feet had been found in the Mediterranean; but that the largest specimens known were those found on the coast of North America (Vancouver's Island), one of which had been measured by Mr. J. K. Lord, who found the length of one arm to be 5 feet.

From this it would seem not to be generally known, even by naturalists, that a species of octopus is very common on some parts of the coast of New Zealand, and notably in Dunedin Harbour, the average size of which is fully equal to, while it occasionally exceeds, that of the specimen from Vancouver's Island just referred to.

I have recently had mounted for this Museum a female *Octopus maorum*, the longest arm of which is 4 feet 3½ inches, but larger specimens have been frequently seen by my assistants and myself. The following are the dimensions of the largest individual—a male—which we have actually measured:—

| | | Feet | Inches |
|---|---|---|---|
| Length of body and head | | 1 | 1 |
| Diameter of body | | 0 | 8 |
| Length of arms— | | | |
| 1st pair | Left | 5 | 5 |
| | Right | 5 | 3 |
| 2nd ,, | Left | 4 | 10 |
| | Right | 5 | 2 |
| 3rd pair | Left | 4 | [illegible] |
| | Right (hectocotylised) | 3 | 11 |
| 4th ,, | Left | 4 | [illegible] |
| | Right | 4 | [illegible] |
| Diameter of largest suckers (on 1st or "dorsal" arms) | | 0 | [illegible] |

Besides the hectocotylisation of the third right arm, the striking difference between the two series which I have mentioned. In the male the suckers simply undergo a diminution in size in passing from the proximal to the d... of the arm; they retain their characteristic form, and m... counted up to about half an inch of the tip. In the fe... the other hand, the suckers become quite indistinct f... inches, and in some cases for fully a foot, from the extr... the arm, taking on the form of small tubercle-like eleva... an instance of this difference I may mention that in ... specimen with the first left arm 4 feet 2½ inches in leng... 292 to 319 suckers could be readily counted on each arm; in a female with the corresponding arm of the same leng... 90 to 115 could be counted on each arm, the dista... bearing tubercles so crowded as to make it practically im... to count them.

T. JEFFERY PA...

Dunedin, N.Z., June 19

[1] The model referred to was exhibited and described in detail at a meeting of the Otago Institute on June 9.

[2] "The Octopus; or, the 'Devil-Fish' of Fiction and of Fact." (Chapman and Hall, 1875.)

[3] One of the "Handbooks" of the Fisheries Exhibition, 1883.

## THE BRITISH ASSOCIATION

### SECTION H—ANTHROPOLOGY

Prof. W. Turner read a paper on *The Index of the P... as a Basis of Classification.*—That the inlet to the ... presented variations in outline and in the propor... conjugate and transverse diameters has been recog... the publication by Vrolik in 1826, and by M. T. Weber ... of their important memoirs on the pelvis in certain race... In 1866 Zaaijer, of Leyden, in his study of the pelvis ... of Java, recognised differences in form in women of ... race, and he expressed these differences numerically. ... transverse diameter as = 100, and then multiplying ... jugate diameter by 100, and dividing by the transv... numeral so obtained is the index of the pelvic brim, or ... index." By applying this method to the pelvis in ... races of man, a classification of races based on the in... brim may be framed. In carrying out this method ... pelvis should especially be studied, as in women the p... sexual reasons, does not present such wide divergence ... form of its inlet as in men. To give precision to the clas... it will be advisable to employ special terms, and in ... far as possible to bring these terms into accordance w... employed in the classification of crania based on diffe... the relations of the length to the breadth of the sk... terms will be employed. Thus dolichopellic will ... a pelvis the conjugate diameter of which is longer ... the transverse, or closely approaching to it; plat... a pelvis in which the transverse diameter greatly ... the conjugate; and mesatipellic, a pelvis in which th... verse diameter is not so greatly in excess of the c... Owing to the comparatively limited number of pelve... different races of men which have been measured, eithe... not be possible to fix definitely at present the numera... of each of these groups; but the following were adopt... visionally by the author:—dolichopellic, a pelvis with brim ... above 95: platypellic, one with brim index below 9... mesatipellic, a pelvis with a brim index between 90 a... both inclusive. The number of pelvic measurements from ... the author drew his conclusions were comparatively fe... from these it would seem that the dolichopellic division co... Australians, Bushmen, Hottentots, Kaffirs, and Andam... whilst Negroes, Tasmanians, and New Caledonians are m... pellic, and Europeans, Chinese, and probably American In... belong to the platypellic group. When a pelvis has d... pellic characters it approximates in the relations of its tra... and conjugate diameters to the form of the pelvic brim me... in mammals lower than man; and in the dolichopellic Austra... Bushmen, Kaffirs, and Andamanese, the length of the ... on the average greater than the breadth, and this ... animal character.

Mr. W. F. Stanley exhibited a portable scale of ... portions of the human body. The instrument is a sm... scale or rule of ivory, about three inches in length ...

livided on each edge of the two faces by lines which represent the proportions of the human body, the male on the one side, and the female on the other. The opposite edge to that on which the proportions are shown is divided into 100 parts in the same space as the height of the body. The object aimed at by the use of this scale is to compare any person, or statue, or photograph with the model of perfect human form given by John Marshall, or to determine the parts of the body in proportional decimals of the whole, to facilitate description.

Mr. J. Theodore Bent read a paper on *Insular Greek Customs* as seen in the islands of the Ægean Sea. He proceeded to notice the modern Greek customs concerning birth and childhood, comparing them with ancient ones, among the customs described being that of fate-telling, and the notions regarding the deleterious influence of Nereids on children. The customs connected with death and burials were next described, and shown to be the same as those of the Greeks 2000 years ago. Some instances were given of the poetry of death-wails, and it was shown that the belief in Charon and Hades existed still in the islands of the Ægean Sea. Among the other customs described in the paper were feasts for the dead, which could be traced to a remote antiquity, and the ancient belief in vampires still survived. Instances were also given from agricultural life of the identity between ancient and modern customs, including the ceremony gone through before sowing of seed, the use of skins for grain, the granaries in the ground, in the kind of agricultural implements used, and also in the names used for animals.

Gen. Pitt-Rivers explained the provisions of the Act of Parliament relating to the preservation of ancient monuments. The Act scheduled the most important and best-known ancient monuments in the country, and provided that these should be registered, and after their registration, although they remained the property of the owner of the land on which they were situated, and might be sold along with the land, could not be destroyed by the owners. There were also a vast number of minor monuments of great interest and value well worthy of being preserved. It was not proposed that the Government should meddle with these minor monuments. What he (Gen. Pitt-Rivers) had done with regard to these minor monuments was to endeavour to see all the principal gentlemen most interested in local archæology, and ask them to let him know when any injury was done to monuments in their district. In the Island of Lewis the agent of Lady Matheson had promised to assist him in every way he possibly could; and Dr. Aitken, Inverness, had promised to him to do the same thing; and he had received promises of a like kind from a number of other gentlemen. In his wanderings throughout the country in connection with the working of this Act of Parliament, he had found no owner of the monuments schednled in the Act unwilling to put his monument under the Act because he wished to destroy it. The feeling of those who were unwilling to put their monuments under the Act had rather been that they considered they were quite as able and willing as the Government to preserve the monuments. What the State desired was to preserve the monuments in the hands of any owners into whose hands they might fall. In these days there was no knowing to whom land might belong now that the gospel of plunder was proclaimed, and it was desirable that there should be some sort of security that the monuments might be preserved hereafter. As the result of his wanderings in order to work this Act in England and Wales, about half of the owners of the scheduled monuments had voluntarily placed them under the protection of the Act. In certain cases the monuments were leased, and the proprietors refused to place them under the Act without compensation, which the Government could not give.

Miss A. W. Buckland read a paper on *American Shell-Work and its Affinities*. In this paper the attention of anthropologists was called to some remarkable works in shell recently discovered in mounds in various States of North America, as described by Mr. W. H. Holmes in a valuable contribution to the *Proceedings* of the Bureau of Ethnology, Washington. These shell-works consist not only of beads of various shapes and sizes, but also of celts, fish-hooks, chips, and other implements of war and [illegible] bracelets, pins, crosses of various for[illegible] masks and elaborately engraved [illegible] which seems to bear some religious [illegible] From the fact that implement[illegible] are found in the islands [illegible] peculiar symbols engrave[illegible] reappear slightly altered on shell gorgets in the Solomon and Admiralty Islands, and also on the great Japanese drum exhibited this year at the Inventions Exhibition, the author inferred that a commerce existed between the islands of the Pacific and the American continent prior to the Spanish conquest.

Mr. E. F. im Thurn read a paper giving an account of the red men about Roraima, in British Guiana. In the paper an interesting account was given of the journey to Roraima, the scenery being described, as well as the manners and customs of the natives. In some of the villages visited the natives had never previously seen white men, and the utmost excitement was caused by the arrival of Mr. im Thurn. The natives of the villages visited were repulsively ugly, and it was almost impossible to distinguish men from women by their dress. The native tribes lived in remarkable isolation from each other, and even the different families in the same village lived in remarkable isolation from each other. There were traces of the Stone Age to be found of high interest. Stones were shaped into adzes and wedges, and they were often made into forms of animals, or of whistles, and models of bottles, which the natives had seen. There was among these tribes a revival of the ancient art of making stone implements, though these implements were simply regarded as ornaments. The natives also made drawings of rocks, which were used as ornaments, and which were evidently imitations of the drawings seen on the actual rocks. Mr. im Thurn closed his paper with an account of a number of some very remarkable games played by the tribes for the amusement of the visitors, in which the movements of animals were imitated in dances.

Mr. J. W. Crombie read a paper entitled *A Game with a History*, which was really an exposition of the antiquity, universality, and signification of the well-known game of "Hop-Scotch," a term which is probably a corruption of "hop-score." The author commenced by pointing out that as children in their play generally imitate something they have observed to be done by their elders, and a game once introduced is handed down from generation to generation of children long after its original has ceased to exist, many innocent-looking children's games conceal strange records of past ages and pagan times; hence the importance of the study of this apparently frivolous subject is now fully recognised by anthropologists. The game of "Hop-Scotch" is one of great antiquity, having been known in England for more than two centuries, and it is played all over Europe under different names. Signor Pitrè's solar explanation of its origin appears improbable, for, not only is the evidence in its favour extremely weak, but it would require the original number of divisions in the figure to have been twelve instead of seven, which is the number indicated by a considerable body of evidence. It would seem more probable that the game at one time represented the progress of the soul from earth to heaven through various intermediate states, the name given to the last court being most frequently Paradise or an equivalent, such as Crown or Glory, while the names of the other courts correspond with the eschatological ideas prevalent in the early days of Christianity. Some such game existed prior to Christianity, and the author considers that it has been derived from several ancient games; possibly the strange myths of the labyrinths may have had something to do with "Hop-Scotch," and a variety of the game played in England under the name of "Round Hop-Scotch" is almost identical with a game described by Pliny as being played by the boys of his day. The author believes that the early Christians adopted the general idea of the ancient game, but they not only converted it into an allegory of heaven, with Christian beliefs and Christian names, they Christianised the figure also; abandoning the heathen labyrinth, they replaced it by the form of the Basilicon, the early Christian church, dividing it into seven parts, as they believed heaven to be divided, and placing Paradise, the inner sanctum of heaven, in the position of the altar, the inner sanctum of their earthly church.

Mr. George Campbell, M.P., read a paper entitled *The Rule of the Road from an Anthropological Point of View*, in which he main[illegible]-handed people the rule of going [illegible] was the most scientific and [illegible] ing, he maintained, to be [illegible] he held that the British [illegible] for footpaths, and [illegible] ation.

[illegible] *of Grinding* [illegible] Aberdeen- [illegible] used for drying corn before sending it to the mill. The kiln was conical in shape, joists called cabers were laid across, some distance from the ground, and above these were roughly-hewn sapplings called simmers; on the top of these was spread straw, and on the straw was laid the corn. A fire was kindled on the ground, and the heat therefrom dried the corn. A stone called a sparker was placed above the fire to catch the sparks, but in spite of this precaution the kiln sometimes took fire. At an early period corn was ground between two millstones, with an iron rod by way of a handle; this primitive mill was called a quern, and was generally turned by two women, as in Eastern lands. In later times querns were used for grinding malt.

Mr. A. J. Evans contributed a paper on *The Flint-Knappers' Art in Albania*, and exhibited some beautifully-worked gun-flints and strike-a-lights, partially cased in ornamented lead sheaths studded with glass gems.

Mr. W. M. Flinders Petrie read a paper on *The Discovery of Naukratis*, the remains of which city had been brought to light during the work of the Egypt Exploration Fund in the first half of this year.

Mr. Thomas Wilson read a paper on *A New Man of Mentone*, in which he described the discovery, in March, 1884, in one of the famous caverns at Mentone, of a skeleton, believed to belong to the Palæolithic age. The excavations were made during the winter of 1883–4 by M. Louis Julien, of Marseilles, and at his expense, aided by the advice of M. Bonfils, Curator of the Museum at Mentone. This cavern had been searched many times before, and about 9 or 10 feet in depth had been removed from the original surface, which, however, was plainly marked by a large piece of *brèche* which still adhered to the perpendicular side wall. The formation of the floor of the cavern and the process of its filling up presented all the usual evidences of human occupation and industry: charcoal, burnt earth and ashes, hearthstones, split and broken bones of animals (estimated to the number of 15,000 pieces), flint instruments, chips, nuclei, &c., &c., were found in sufficient number, quantity, and distribution to indicate an indefinitely long occupation. No morsel of pottery was found, nor were any of the stone implements polished. At the depth (from the original surface) of 8 metres 40 centimetres was found the skeleton of this "new man of Mentone." He was laid on his back with his limbs extended, and had for funeral equipments three large chips of flint (*éclats de silex*), 6 or 7 inches long and 2½ inches broad, in the form of the largest scrapers, placed one on each shoulder like epaulettes, and one on the brow. It was evidently an interment. This became more evident when it was found that the body was placed in a sort of natural vault or tomb, formed on one side by the wall of the cavern, and on the other by an immense block of stone with an overhanging edge, which reached to a line perpendicularly over the centre of the skeleton. This placing of the body required an excavation between these rocks of 3 or 4 feet in depth. The skull was broken into sixty fragments by the pick of the workman; it was carefully taken up and put together by M. Bonfils, and is now exposed in the Museum at Mentone. This was a fortunate accident, for while the rest of the skeleton was being exhumed a quarrel broke out as to ownership, which ended in the theft and utter destruction of all that remained. Mr. Wilson maintained that the new discovery of the skeleton dissipated all idea of disturbance, for while disturbance might exist for one or two, or even five or six feet, to the depth of twenty or thirty feet it would be impossible. It must be conceded that the human industry as manifested by the objects found in these caverns, indicated their occupation during the palæolithic age, for of the thousands found, all bear the impress of that age, while none denote particularly the age of polished stone. Mr. Pengelly said that he had visited the cavern where M. Rivière's new man of Mentone was found, and he was of opinion that the man found by M. Rivière had not been interred at all, but had died where the body was found, and had been buried by the sand blown into the cavern, and the waste of the walls of the cavern. He had measured the place himself where the body was found, and found that it was only eight feet below the surface. The skull of the man was so good that he should have been glad to have possessed such a skull. It was a large skull, and the measurements he made of the bone showed that the man must have been of great stature. The bones of animals found in the cavern [illegible]tly those of animals now extinct, and partly those of [illegible] [illegible]ecies. With reference to the age in wh[illegible] [illegible] man [illegible] [illegible]vière lived, his impression was [illegible] palæolithic age. He would not say so positively, howe[illegible] from the information they possessed he did not think [illegible] man would be of any value whatever for or against the [illegible] of human antiquity.

Dr. R. Munro read a paper on *The Archæologi[illegible] of Ancient British Lake-Dwellings and their [illegible] Analogous Remains in Europe.* Dr. Munro comme[illegible] giving a short introductory notice of the discovery an[illegible] tion of the crannogs of Ireland and the lake-dwellings [illegible] Europe. He then gave a *résumé* of the more recent e[illegible] made among the crannogs of Scotland and the re[illegible] objects recovered from them. From a comparative ex[illegible] of these relics with other collateral antiquities of the [illegible] arrived at the conclusion that the lake-dwellings of [illegible] were essentially the product of Celtic genius, that [illegible] constructed for defensive purposes, and that those in [illegible] west parts of the country attained their greatest devel[illegible] post-Roman times, after Roman protection was withdr[illegible] the provincial inhabitants, and they were left single-h[illegible] contend against the Angles on the east and the Picts [illegible] on the north. Having established the Celtic orig[illegible] crannogs of Ireland and Scotland, Dr. Munro proce[illegible] inquire if there is any ancestral relationship between [illegible] the lake-dwellings of Central Europe. Taking into a[illegible] recent discovery of lacustrine abodes in the Holderne[illegible] few previous records of their existence in Wales and [illegible] of England, together with the statement of Cæsar [illegible] Britons were in the habit of making use of wooden [illegible] marshes in their defensive works, he thought that [illegible] tions are not merely solitary instances, but the ou[illegible] widely distributed custom which prevailed in the sou[illegible] of Britain at an earlier date than that assigned to the [illegible] of Scotland. Hence he suggested the theory that the Celts were an offshoot of the founders of the [illegible] dwellings, who emigrated into Britain when these l[illegible] abodes were in full vogue, and so retained a knowle[illegible] custom long after it had fallen into desuetude in Eu[illegible] this hypothesis it would follow that subsequent immig[illegible] Britain, such as the Belgæ, Angles, &c., being [illegible] acquainted with the subject, would cultivate new and improved methods of defensive warfare; whilst the fi[illegible] invaders, still retaining their primary notions of c[illegible] when obliged to act on the defensive would natur[illegible] recourse to their inherited system of protection. In [illegible] this hypothesis the author pointed out that the geograp[illegible] tribution of lake-dwellings, so far as they are known [illegible] closely corresponds with the area formerly occupie[illegible] Celts; that no lake-dwellings have been yet found eith[illegible] northern or southern parts of Europe, though the top[illegible] and hydrographical conditions of these regions are not [illegible] able for such structures; that the *fascine* dwellings [illegible] were identical in structure with the crannogs; and that the pile-dwellings were not largely used in the Brit[illegible] the principles on which they were built were not unkno[illegible] disuse being due to topographical and other cons[illegible] Finally, he argued that the wideness in the chronolo[illegible] which is supposed to separate the crannogs from [illegible] dwellings of Europe is more apparent than real, as [illegible] existed during the Roman occupation of Gaul, and [illegible] instance at least the custom survived to about the [illegible] century.

Prof. D. J. Cunningham exhibited a large coloured [illegible] sections of a young chimpanzee, illustrative of some [illegible] points of comparison between the chimpanzee and man. Cunningham said that he had purchased a male chim[illegible] which was said to have died in the process of second de[illegible] and which he believed to be about six years of age. Th[illegible] of the chimpanzee was frozen for two days, and he [illegible] hibited the sections of the chimpanzee for the purpose [illegible] one or two points of comparison between the chimpa[illegible] man. Any[illegible] [illegible]king at the plate would be attracted [illegible] region o[illegible] [illegible] the protrusion was sho[illegible] so well [illegible] [illegible]nimal. If they com[illegible] corres[illegible] [illegible] they would find [illegible] forcibl[illegible] [illegible] An anato[illegible] [illegible] attention [illegible] [illegible] beautifully [illegible] [illegible] different regi[illegible] [illegible] man in a grea[illegible] [illegible]

:markable that the chimpanzee even at six years of age there as a very manifest lumbar curve. In the Biological Section iat day there had been described the spine of a child six years f age, and it was remarkable that the lumbar curve in this iimpanzee of a corresponding age was very much more marked ian in the child. At six years the chimpanzee was much more lvanced in life than a child six years old, and therefore his ımbar curve was correspondingly greater. If they wished to et at the distinction between the spine of man and the iimpanzee they must look lower down at the sacrum. After oticing one or two other points, Dr. Cunningham drew the onclusion that the human child occupied an intermediate posion between the chimpanzee and the human adult. In the plate e now exhibited they would see compared the skull of the iimpanzee with that of man, bringing out that the cerebral or ırger brain in man extended a good deal further back than in ie chimpanzee; and there was not much difference between the lew World ape and the chimpanzee in that respect.

Dr. J. G. Garson, one of the secretaries of the Section, read a aper on *Abnormal and Arrested Development as an Induction of Evolutionary History*. Dr. Garson began by stating that, erhaps, the most fertile source of information regarding the istory of man's evolution was derived from a study of his mbryological development. Another source from which much aluable information regarding the early history of our own pecialisation, and that of other animals, might be gleaned, was eratology, which had for its domain the consideration of bnormal conditions of development. Many of the conditions ıcluded under this branch were of a pathological nature, and ue to the effects of disease; others, however, were not—such, ır example, as an abnormal and an unusual production of ormal structures and cases of arrested development. It was to consideration of some conditions occurring under one or other these categories that he ventured now to call attention. The xamples which he had selected had come more especially under s own observation. Persons were occasionally found with bnormal development of hair on their bodies. The type of animal was an animal whose body was covered with hair. nder certain circumstances the hair might more or less dis. ppear, according to the conditions under which the animal ved. In man it was only feebly developed, except on the ead; and in the cetacea or whales it had entirely disappeared, ith the exception of a very few bristles near the mouth. Dr. arson proceeded to explain how excessive development of hair kes place in man. In ordinary cases the hair-growing appatus in the embryo remained stationary, instead of keeping ice with the growth and development of the other organs the body, with the result that no hairy covering such was found in other mammals was present, but only ort rudimentary hairs appeared at intervals. But in me exceptional cases this stationary condition of the hair llicles did not occur, and they went on actively developg with the rest of the body, with the result that a hairy vering was produced over the body. The hairless condition ıw normal in man had evidently been gradually acquired rough a long period of time, as such a change could not take ace rapidly and become such a stable condition as it was found be otherwise. Abnormal development of fingers occurred metimes in man, but must be classed entirely apart from such rms of abnormality as had been considered in the hair-growth. arrested development the abnormal organ or portion of e body, instead of going through the various stages it usually es till it arrives at the condition it normally assumed in the oup of animals in which it occurs, stops short at one or other ages. The stage at which it stops may correspond to that iich is normal in a lower grade of animal life, and so gives rect evidence that the higher forms of animal life, such as man, ss through and beyond the stages at which the lower stop. It ıst not be forgotten also that in some respects an animal of a ver grade may possess specialisations in some structures or gans of a higher ground than animals much higher in the ale of life.

Dr. Robert Laws, from Livingstonia, Lake Nyassa, East ntral Africa, read a long and interesting paper descriptive of manners and customs of the Bantu tribes living around Lake ... in Eastern Central Africa. In the outset of his paper ... said that Lake Nyassa was 350 miles long, and varied ... miles broad, and around that vast inland sea they ... different tribes, speaking so many different ... dialects of these languages. Though these tribes had much in common, they differed among themselves in many of their habits, customs, and religious beliefs. He proceeded to notice the names and residences of the leading tribes, and gave a brief summary of what was known of their history. As a rule, he said, the people of all these tribes were physically developed, but their vigour and general healthy condition differed considerably, depending chiefly on the climate, soil, and food. Where maize and mapira were the staple foods, the natives were strong and hardy. Where cassava root was their chief food, and especially if along with that there was a state of actual or dreaded warfare, the people were weak and sickly. On the hills the people were hardier and more vigorous than on the lake-shores and on the river-banks. Mental energy was greater on the hills than at the lake-side, and at places where there was most radiated heat this was less than where the breezes played freely. Keenness of vision and acuteness of hearing were spoken of as being remarkable in civilised tribes, and among the lake tribes these faculties attracted the attention of travellers, but Dr. Laws was inclined to attribute these characteristics to training and exercise in given directions rather than to any radical superiority in the organs of sight and hearing among the tribes. All the tribes depended principally on agriculture for their support, and the only appearance of a rudimental division of labour was to be found in the classes of fishermen and blacksmiths. No traces of a Stone age had been found among these tribes. Yet in certain districts they were to be found cultivating their gardens with tools of hard wood instead of iron, distance from markets being the cause of their use. At the east side of Nyassa many lake-dwellings were found in 1875, and often on war being threatened the inhabitants of the lake shore took refuge by living in such constructions. Iron mines had been found, and copper had been found in one of those near the Livingstone range. The iron of the mines was usually near the surface. Charcoal was used for smelting. Dr. Laws went on to describe the manner in which the tribes made their canoes, their nets, and their huts. Fire was procured among them by the rapid rotation of rods of wood between the hands, the spark being caught in cloth and kindled into a flame. The natives exhibited great surprise when they saw the traveller strike a lucifer match, and that was regarded by them as an unquestionable proof of his superior knowledge. The natives indicated time by pointing to the position of the sun. They named Sunday as the day of God, Monday as the day for beginning work, Saturday as the day for stopping work. The intermediate days were indicated by numbers. The eclipse of the moon was described as the moon put in a bag, and comets as stars with tails. Slavery was common in all the tribes, and half of its horrors had not been told. Infanticide was not practised, but infant mortality was very high, and cases had been found of children labouring under a lingering disease having been buried alive. Polygamy was common, and the number of a man's wives taken as an index of his wealth. One chief told him he had a hundred wives, and he (Dr. Laws) believed he was rather under-estimating than overestimating the number. The early marriage of girls was the rule, and in one tribe a girl was often betrothed before she was born. In buying land they had to buy it first from the chief and then buy the tenant-right from the cultivators. After describing the customs of the tribes relating to the punishment of crime, Dr. Laws concluded his paper by noting the leading peculiarities of the language of the tribes, directing especial attention to the complications in the forms of speech, and especially to the extraordinary number of variations in the verbs.

Mr. E. H. Man contributed a paper on *The Nicobar Islanders*. —In the interior of Great Nicobar there is a wild race, styling themselves "Shab Dawá," of whom as yet little information has been obtainable; they are distinct from the inhabitants of the other islands and of the villages on their own seaboard, who are of Malay origin, and by whom they are called "Shom Peñ" ("Shom" denoting tribe," and "Peñ" being the tribal designation). It appears certain that they are the descendants of a very ancient aboriginal population of Mongolian origin. The first mention that we find of them is from the pen of pastor Rosen, a Danish missionary, who, while resident at the Nicobar Islands between the years 1831–34, spoke of them, from hearsay, as in much the same degraded condition as we find them at the present day. He said that "they wear no clothes, possess no houses, live like animals in the depths of the forest, and shun the sight of men, never leaving their lairs except to search for food, which they sometimes steal from such of the coast huts as are temporarily vacated or occupied only by a few aged or infirm folk whom they are able to surprise or overpower." In 1876 and 1881 a few members of this tribe living near the north-east of Great Nicobar were seen by the late Mr. de Röepstorff, who was accompanied in the latter year by Col. T. Cadell, V.C., Chief Commissioner of the Andamans and Nicobars. During the last eighteen months Mr. E. H. Man, while in charge of the Nicobar Islands, has paid six visits to Great Nicobar, on four of which he succeeded in seeing and photograhing parties of this tribe, both near Ganges Harbour and on the west coast. On the first of these occasions (viz. February 1884) two youths, aged about eighteen and fourteen years respectively, were persuaded to leave their friends for seven days, at the end of which they were conveyed back from Nancowry in the settlement steamer. During their visit to Mr. Man they proved themselves tractable and timid, and submitted with a good grace to ablutions which were found very necessary. Although this is the first recorded instance of a Peñ having ventured from his savage haunts, these lads exhibited the Oriental characteristic absence of wonderment at all the novel surroundings and tokens of civilisation in the Government settlement. They were fair specimens of their race, the members of which are found to be usually well nourished, of good physique, and, while young, favoured with pleasant features. The height of the males appears to range between 5 feet 2 inches and 5 feet 8 inches; their skin is fairer than that of the generality of the coast people, who, on their part, are less dark than the Malay; the hands and feet seem to be decidedly large, and bear evidence of the rough work of their daily lives; the hair, which is straight, is commonly worn uncut and unkempt, and, as habits of cleanliness are manifestly foreign to their nature, its condition can better be imagined than described. As a result of their friendly intercourse in recent years with the coast people, they have acquired the habit, so universally practised among the latter, of chewing the betel-nut (*Chavica betle*) with or without quicklime, and are consequently beginning to be similarly disfigured with black teeth, though not yet to the hideous extent common among their more civilised, or, rather, less savage, neighbours. They likewise now imitate the latter in respect to clothing, the men adopting the narrow loin-cloth and the women a small cloth skirt. Their dwellings are small, and cannot compare with those of the coast people, and are indeed but little, if at all, superior to those of the Negritos in Little Andaman, but they more nearly assimilate the former in design as well as mode of construction, for they are erected on posts; the floors being raised 6 or 7 feet above the ground necessitate the use of ladders. It is impossible, within the limits of this abstract, to make further mention of the dwellings, or to describe the peculiar sack-like cooking-vessels of this strange race. Mr. Man hopes before long to be able to supplement in many particulars the rudimentary information which has hitherto been obtainable regarding the Peñ, but the task is one of considerable difficulty, for, apart from the dread entertained by this tribe towards aliens, their frequent feuds place from time to time a temporary barrier to all intercourse between them and our friends on the coast, through whom at present all our communications have to be conducted. The nearest portion of Great Nicobar Island is, moreover, about 60 miles distant from the Government settlement at Nancowry.

## SCIENCE IN RUSSIA

THE Kazan Society of Naturalists continued last year its valuable explorations of Eastern Russia, and we have before us several new fascicules of its *Memoirs* and *Proceedings*.[1] M. Ivanitsky publishes a list of plants of the Government of Vologda, which contains 804 Spermatophytæ, Gymnospermæ, and Sporophytæ. As to these last, only 6 Equisetaceæ, 5 Licopodiaceæ, and 20 ferns being given, the list obviously will be much extended by subsequent research. The flora of Vologda, which is situated on the limits of the middle and Arctic Russian floras, offers a certain special interest, and M. Ivanitsky has not neglected to mention the wild and cultivated plants which find their northern limits within the province. It consists chiefly of Compositæ (107 species), 49 Cyperaceæ, 48 Gramineæ, 41 to 34 each of Ranunculaceæ, Caryophylleæ, Rosaceæ, and Cruciæferæ, 27 to 22 Papilionaceæ, Scrophulariæ, Labiatæ, Salicineæ, and Polygonaceæ, and 21 to 19 Umbelliferæ, Filices, and Orchideæ. The list of plants is preface[d by] a masterly sketch of the physical conditions of separate par[ts of] the province. The same volume contains a paper by M. [...]lavsky on the irritability of the nervous-muscular system, be[ing] an inquiry into the causes of the well-known differences [in] effects of electrical irritation on the frog, when measured by methods of Dubois-Reymond. All causes which may [bear] upon the conditions of the experiments themselves having [been] eliminated, there still remain notable differences which ma[y be] ascribed to the state of the system altogether. A paper, by Tsomakion, on the laws of transmission of electricity th[rough] gases, embodies the results of several new experiments [in this] field. In a former inquiry the author, by introducing in [the] chain of condensation a discharger where the discharge [could] take place only at close contact of the two electrodes, h[ad ex]perimentally proved the law, already deduced by Fœrselm [and] Heer, that the whole amount of heat produced at the d[ischarge] of the condensator does not depend upon the compositi[on of the] chain. But as soon as he introduced a layer of gas betw[een the] electrodes, he found that his results widely differed fr[om those] previously obtained by other students; he undertook a se[ries of] experiments for discovering the sources of that discrep[ancy; the] results, and he has arrived at a long series of conclusion[s which] are of great interest, but ought to be submitted to a [further] inquiry. This last is continued.—To the same vol. [M.] Zaitseff contributes a paper on the petrography of the cr[ystalline] rocks in the neighbourhood of Krasnovodsk, on the e[ast] shore of the Caspian. The chief rock in the Shakh[...] Mountains, which reach about 600 feet above the se[a, is a] massive, unstratified quartz-dioritic porphyrite (according [to the] classification of Herr Rosenbusch). Between the bays [of ...] vioff and Soymonoff the rocks are closely akin to the above [and] might be described as a quartz-miea-diorite. The former exte[nds] for some miles east of Krasnovodsk, and is intersected by [...] a muscovite-granite (according to Herr Rosenbusch's classifica[tion]) and quartz porphyry of rare occurrence, its ma[gnesia] mica being replaced by a potassium mica.—The same [author] contributes two papers on the petrography of the S[...] valley in the south-east part of the district of Ekatern[burg] which incloses the 3200 feet high Yurma summit and [the] high ridges of mountains. The author makes a detailed [inquiry] into the structure of the crystalline rocks of this locality (gra[nites,] gneisses, and various schists), and is inclined to admit that [at] least one part of the olivine-bearing serpentines endow [their] origin to the metamorphism of the actinolite schists. The [iron] ores and gold-bearing deposits are also described, the a[ge of] these last being undoubtedly settled as Post-Pliocene, as [they] contain numerous remains of Mammoth, *Bos primigenius*, [Cer]*vus tarandus*, and *Cervus alces*. We may remark that the [...] high position of several gold-bearing deposits on the slo[pes of] the valleys and their structure is one testimony more in fa[vour] of their glacial origin, but the author does not touch this [inter]esting question. He mentions also—a fact which has often [been] doubted, but is now confirmed more and more—that the g[old of] these deposits is derived from the decomposition of the c[...] slates. The papers are accompanied by a geological map. [In] the same volume (fasc. 4) we find a preliminary report, by Korzinsky, on a botanical excursion into the delta of the V[olga]. The list of plants is not yet given by the author, and he [pub]lishes only a valuable sketch of the general characters [of the] delta, distinguishing in it two different regions: the delta pro[per,] which consists of fluviatile deposits; and the Steppe reg[ion,] covered with the so-called *bougry*, or a kind of [...] described by Karl Bear and still bearing his name, about [these] *bougry* the author holds a different opinion as to their [...] denying—with full right, we suppose—their origin from [the] retreat of the Caspian.

As to the *Proceedings* of the Kazan Society, we are gla[d to] learn from them that three new meteorological stations (at Se[r]pul, Tcherdyn, and Debessy) have been added to those [already] organised by the Society. There was a great want of meteoro[logical] observations precisely for that part of North-East [Russia]. Several shorter papers are embodied in the *Proceedings*: [on] the geology of the Vetluga region, by P. Krotoff [...] concerning the Permian and Trias, as also the southern [limit of] the boulders).—On the fauna of Kazan (between the [Kama and] Vyatka), by N. Varpakhovsky. The author gives [a list] of fishes found in the lakes and rivers, and [...] serpents and amphibians of the region.—On the [...]

[1] *Trudy Obshestua Estestvoispytatelei pri Kazanskom Universitete*, vol. xiii. fasc. 5 and 6; vol. xiii. fasc. 1 to 4.—*Protokoly* (*Proceedings*) of same for the years 1883 and 1884.

of tripsine, by V. Nikolsky.—On the *bougry* of the Caspian, by A. Zaitseff. They do *not* have the uniformity of structure supposed by Baer; they often cross one another at angles of 20° to 30°, and some of them follow a north-eastern direction, while others, close by, run west and east; and they contain not only broken mussels, as affirmed by Baer, but also plenty of quite full mussels of *Cardium trigonoides*, *Dreissena polymorpha*, *rostriformis*, and *caspia*. The theory of Baer altogether is based on an insufficient supply of data, and the structure of the *bougry* ought to be better explored before pronouncing as to their origin.—On the sulphur ores at Tetushi, on the Volga, by G. Wilenius.

The fourth volume of the "Collection of Materials for the Description of Caucasus,"[1] published by the schoolmasters of Caucasus, contains, as usual, much valuable information, especially of historical and ethnographical character. M. Hahn contributes a most valuable paper of 250 pages, in which he has compiled all information on the Caucasus he was able to discover in authors since Homer up to the fifth century of our era. The information gathered from Byzantine writers who have much more written about the Caucasus, will be embodied in a second part of the work. The importance of this very careful work, where textual translations are given of passages dealing with the Caucasus and its inhabitants from no less than eighty Greek and Latin authors, will be fully appreciated by all those who have to deal with the geography of the country. A complete index will much facilitate the research. M. Eivazoff gives a description of the Aisores of Koiasar, of their manner of life and customs, followed by an Aisor alphabet; and M. Arkannikoff contributes a detailed description of the town Temruk and of the Temruk mouth of the Kuban River. In the second part of the same collection we find a series of interesting notes on the Tchokh village in Daghestan, on Daghestan legends, and on the life of Abkhazes; a collection of Little Russian songs from Kuban; and two lectures on the beautiful seven-centuries-old Georgian poem of Shota Rustaveli.

## SCIENTIFIC SERIALS

THE *Journal of Physiology* for July contains:—Note on the cause of the first sound of the heart, by G. F. Yeo and J. Barrett.—An experimental investigation to ascertain the action of veratria on a cardiac contraction, by S. Ringer (plate 2).—Concerning the action of small quantities of calcium, sodium, and potassium salts upon the vitality and function of contractile tissue and the cuticular cells of fishes, by S. Ringer and D. W. Burton.—A study of the action of the depressor nerve, and a consideration of the effect of blood-pressure upon the heart regarded as a sensory organ, by H. Sewall and D. W. Steiner (plate 3).—On secondary and tertiary degenerations in the spinal cord of the dog, by C. S. Sherrington (plates 4 and 5).—On the structure and rhythm of the heart in fishes, with especial reference to the heart of the eel, by S. A. M'William (plate 6).—The innervation of the heart of the Slider terrapin (*Pseudemys rugosa*), by J. Wesley Mills.—Note on the sound accompanying the single contraction of skeletal muscle, by E. F. Herroun and G. F. Yeo.

*The Journal of Anatomy and Physiology* for July contains: Account of some recent experiments on the effects of very low temperatures on the putrefactive process and some vital phenomena, by J. J. Coleman and J. G. McKendrick, M.D.—Accessory lobe to the left lung, by L. Humphry, M.B. (plate 7).—Case of abnormal development of the reproductive organs of the frog, by A. F. S. Kent (plate 18).—Rotation and circumduction, by Thomas Dwight, M.D.—Movements of the ulna in pronation and supination, by C. W. Cathcart, M.B.—Anatomy of a hydro-monocephalous brain, by A. Hill, M.D.—Corpus callosum in the adult human brain, by Dr. J. Hamilton, (plates 21 and 22).—Tumours in animals, by J. B. Sutton (plate 23).—Hyomandibular clefts and pseudobranchs of Lepidosteus and Amia, by R. Ramsay Wright (plate 24).—Anatomy of *Spina bifida*, by Prof. Humphry.—Notes on some variations of the shoulder muscles, by W. B. Ransom.—Tarsus and Carpus, by Prof. K. Bardeleben.

*The Quarterly Journal of Microscopical Science* for July contains:—On spermatogenesis in the rat, by Herbert H. Brown (plates 22 and 23).—A simplified view of the histology of the

[1] "Sbornik materialov dla opisania myestnostei i plemen Kavkaza," [illegible]

striped muscular fibre, by B. Melland (plate 24).—On the development of a freshwater macrurous crustacean (*Atyephora compressa*), by C. Ishikawa (plates 25–28).—On the supposed communication of the vascular system with the exterior in Pleurobranchus, by A. G. Bourne, D.Sc. (plate 29).—Observations on the nervous system of Apus, by P. Pelseneer (plate 30).—Note on the chemical composition of the zoocytium of *Ophrydium versatil*, by W. D. Halliburton, M.D.—The development of *Peripatus capensis*, by A. Sedgwick, M.A. (plates 31 and 32).

*The Journal of the Royal Microscopical Society* for August contains:—The pathogenic history and the history under cultivation of a new bacillus (*B. alvi*), the cause of a disease of the hive bee hitherto known as foul brood, by F. R. Cheshire and W. Watson Cheyne, M.D. (plates 10 and 11).—Experiments on feeding some insects with the curved or "comma" bacillus, and also with another bacillus (*B. subtilis?*), by R. L. Maddox, M.D.—On four new species of the genus Floscularia and on five other new species of Rotifera, by C. T. Hudson, LL.D. (plate 12), with the usual summary of current researches.

*The American Naturalist* for September contains the reputation of the Lantern fly (*Fulgora lanternaria*), by John C. Branner. To the bibliographical references made in an editorial note to this paper may be added the spirited discussion on the whole subject in the *Entomological Magazine* of 1836.—The age of forest trees, by J. T. Campbell.—The relations of mind and matter, by C. Morris.—The exhalation of ozone by odorous plants, by J. M. Anders and G. B. M. Miller.—Glacial origin of Presque Isle, Lake Erie, by J. D. Ingersoll.—Recent literature and general notes.

*The Proceedings of the Linnean Society of New South Wales*, vol. x. Part 1 (June 4).—The papers in this part are of great interest, and worthily sustain the credit of this most active and energetic Society. *Zoology*—Dr. R. von Lindenfeld, On Australian sponges, part iv. The Myxospongiæ, with 5 plates. On *Amœba parasitica*, a new protozoon infesting sheep. On the Phoriospongiæ.—William Macleay, On a new snake from the Barrow Ranges, and On some reptiles from Herbert River.—A. S. Oliff, On some Ceylonese Coleoptera.—J. Brazier, Synonymy of some shells described by Dr. Gray.—W. A. Hasnell, On some Australian Amphipods, with 9 plates.—Captain Hutton, Revision of the Toxoglossate mollusca of New Zealand.—J. Douglas Ogilby, Some rare Port Jackson fishes. *Botany*—Dr. W. Woors, Australian Proteaceæ. *Palæontology*—F. Rattle, On a Devonian Australian fossil allied to Worthenia, with a plate; also on the Glacial period in Australia; and on the meteorology of Mount Koskiusko, by Dr. von Lindenfeld, with two plates.

*Morphologisches Jahrbuch*, Band 11, Heft 1, contains:—Contribution to a knowledge of the renal organ of the Prosobranchia, by Dr. B. Haller (plates 1–4).—On the morphological significance of the nucleus, by Dr. W. Pfitzner (plate 5).—Short contributions to a knowledge of some marine Rhizopods, by O. Butschli (plates 6 and 7).—On the significance of the *Linea semicircularis Douglassii*, by Bernhard Solger.—Notes on Apseudes, by J. E. V. Boas.—Short Notes.

*Zeitschrift für wissenschaftliche Zoologie*, Band 42, Heft 1, July 24, contains:—A biographical sketch of Carl Theodor Ernst von Siebold, one of the founders of the *Zeitschrift*, by Ehlers (with a photograph).—On the significance of the nucleus from the point of view of evolution, by Prof. A. Kolliker.—Researches on some Flagellates and kindred organisms, by Dr. C. Fisch (plates 1 to 4).—On the anatomy of the Amphisbœna, by Dr. Carl Smalian (plates 5 and 6).

Band 42, Heft 2, August 18, contains:—An essay on the history of German slugs, and on their European allies, by Dr. H. Simroth. This monograph is illustrated by five plates, that of the species being coloured.

## SOCIETIES AND ACADEMIES

### PARIS

**Academy of Sciences**, October 5.—M. Bouley, President, in the chair.—Spectral analysis of the elements of the terrestrial atmosphere, by M. J. Janssen. The author describes the special arrangements that have been made at the Meudon

Observatory for the study of the hydrogen, oxygen, and other substances present in the terrestrial atmosphere. Four tubes, one 60 metres long, have already been fitted up in a chamber in which solar, electric and other lights can be employed under favourable conditions.—Thermic studies of the aromatic series: the phenols of complex function, by M. Berthelot. New characters derived from thermo-chemistry have been determined for the purpose of distinguishing the various isomerous groups of the aromatic series and disclosing the phenolic function belonging more particularly to some of these groups. In order to establish the general character and importance of this new instrument of research, the author continues his experiments with the compounds derived from the oxybenzoic acids, to which the synthesis of vanilline and the allied substances has given so much interest. The results already obtained establish a perfect agreement between the thermic indications and the chemical theories respecting the complex phenolic functions.—The treatment of mildew and rot with a mixture of lime and sulphate of copper, by M. A. Millardet. During the present season M. Nathaniel Johnston has applied this new process to 50,000 vines in the Médoc district with complete success. The plants so treated are in a perfectly healthy state, while those not treated are in a wretched condition.—On the destruction of mildew by the sulphate of copper, by M. A. Perrey. A solution of 5 per cent. of sulphate of crystallised copper has this year been successfully and economically applied to vineyards in Burgundy hitherto unsuccessfully treated with sulphur.—Ravages of mildew in the northern districts of Touraine during the present year, by M. Larreguy de Civrieux. The disease broke out suddenly a few days after a violent storm in July, attacking several varieties of the vine and the oak trees of the surrounding plantations to the exclusion of all other plants.—Note on the quadratic forms in the theory of the linear differential equations, by M. Halphen.—On the physiologic action of the salts of rubidium, by M. Ch. Richet. Subcutaneous and intra-venous injections of the chloride of rubidium applied to frogs, fishes, rabbits, guinea-pigs, and pigeons, show that this metal has the same toxic effect as potassium, but somewhat less virulent.—On the internal phenomena of muscular contraction in the striated primitive fasces in *Corethra plumicornis* and the frog, by M. F. Laulanié.—Line of development followed by the inoculated virus of tuberculosis in man, the rabbit, and guinea-pig: application to the study of inoculation and re-inoculation for tuberculosis, by M. S. Arloing.—A remarkable vegetable centre in the peninsula of Brittany, by M. L. Crié. Of this vegetable zone the characteristic species appear to be *Narcissus reflexus*, Lois.; *Eryngium viviparum*, Gay; *Omphalodes littoralis*, Leh.; and *Linaria arenaria*, D. C.—Application of thermo-chemistry to the explanation of geological phenomena; general principles; ores of manganese, by M. Dieulafait. The principle is laid down that of all the natural combinations of each metal, that which developes the greatest heat in its formation occurs most extensively in nature, and must be regarded as its principal ore. Applying this principle to the study of manganese, the author finds that the ores of this metal exist in nature in the relative proportions and under the conditions anticipated by the laws of thermo-chemistry.—On the whirlwinds observed by aeronauts, by M. Diamilla-Muller. These whirlwinds are attributed to the collision of two atmospheric currents coming from opposite directions, and are compared with the eddies produced in streams by analogous causes.—Note on a meteor observed at Saigon, Cochin-China, on August 22, 1885, by M. Réveillère.—Kinematics of the locomotion of quadrupeds: trajectories and comparative velocities of the pastern and hoof of the horse at the different phases of its motion.

STOCKHOLM

**Academy of Sciences**, September 16.—The following paper was presented and accepted for publication in the *Proceedings*:—"Nouvelles Observations sur les Traces d'Animaux et d'autres Phénomènes, d'Origine purement mécanique, décrits comme Algues fossiles," by Prof. A. G. Nathorst.—Experiments to determine with the galvanometer the limits of elasticity and the absolute tension of iron wire of different thickness and with varying contents of carbon, by Dr. P. Isberg.—Researches on the influence of temperature on the electromotoric force of certain electric pile combinations, by Dr. F. Kahlmeter, both the latter papers being presented and explained by Prof. Edlund.—Prof. Wittrock referred to a report left by the late Dr. Lönnroth on his botanical journey to Gothland and Öre-land, chiefly to study the Hieracia, at the expense of the Ac... and to a paper presented at a previous meeting and prep... the Botanical Section of the Natural History Museum ... R. Boldt.—Contributions to our knowledge of the ... phyllophyceæ of Siberia. He further presented and ex... the two following papers, viz.:—Contributions to our k... of the development of the physiological tissue of some ... Herr N. Wille, and contributions to the flora of the ... Desmidicæ, by Herr G. Lagerheim.—Prof. Chr. Au... presented a paper, "Conspectus Generum et Sp... Microceridarum," and gave a review of the same. He ... exhibited living specimens of the slave-keeping ant, *F... rufescens*, recently found by him near Stockholm.—Prof. ... presented a paper prepared by himself and Prof. O. Pe... "Nouvelle méthode pour déterminer la densité de ... corps volatisables en même temps que la tempéra... pliquée," and gave a review of its contents.—The ... (Prof. Lindhagen) presented the following papers on the results of researches made at the Upsala Chemical ...tory:—On the production and nitrification of ... acid; on the ortoderivates of kumenylacryl acid and the ...digo and chinolin-derivates obtained from the same; ... derivates of kumenylacryl acid, and on derivates of ... acryl acid formed through substitution in the ... acryl acid: all four by Dr. O. Widman.—Researches ... dependence of galvanic resistance in certain alloys ... bismuth on time, by Dr. G. Backlin.—On capacity of ... and atomic weight, by Dr. J. R. Rydberg.—On ... a new mineral from the mine Sjögrufvan, in the ... Örebro, by Herr L. J. Igelström.—Remarks on the ...teosoma, Guérin-Méneville, by Dr. C. Bovallius.—On ... Wettern and the formation of Visingsö, an island, by ... Holm.

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THURSDAY, OCTOBER 22, 1885

## AMERICAN ANTHROPOLOGY

*Reizen en Onderzoekingen in Noord-Amerika.* Van Dr. H. F. C. Ten Kate, Jun. (Leyden: Brill, 1885.)

*Prehistoric America.* By the Marquis de Nadaillac. Translated by N. D'Anvers. Edited by W. H. Dall. (London: Murray, 1885.)

*The Lenape Stone; or, the Indian and the Mammoth.* By H. C. Mercer. (New York: Putnam, 1885.)

DR. TEN KATE (son of the celebrated Dutch painter) has published the account of his late anthropological journey in the regions about Arizona and New Mexico. His exploration was supported by the Government of Holland, for whose Rijks Museum at Leyden he brought home a collection illustrating the peculiar civilisation of the Pueblo Indians and their wilder neighbours of the plains; also by several scientific bodies, among them the Anthropological Society of Paris, for which he took body-measurements of the various tribes he met with. Belonging to the school of observers who depend on the measurement of skulls as a means of classing the natives of America into stocks of the general Mongoloid race to which they primarily belong (p. 432), he has to deal with the interesting problem, what relation the ruder and fiercer tribes bear to the comparatively cultured and peaceable dwellers in the pueblos. This, however, is confused by the fact that among neither is the type uniform. Dr. Ten Kate (p. 173) recognises among the Apaches two or three varieties, one more Mongolian and especially seen among the women, the others more of the bold-featured Redskin-type. The brachycephalic and occipitally flattened skull which he considers especially characteristic of the Pueblo Indians, enables him to contradict (p. 155) the opinion that the handsome Pimas belong to these. But then he finds it necessary to divide the Pueblos into much the same Mongolian and Redskin types (see his remarks on the Moquis, p. 253). On the whole his observations do not seem incompatible with the view that the difference between the roving Indians of the skin tents and the tillers of the fields around the towns of mud-brick houses depends less on race than on difference of stage of civilisation, itself due in great measure to the respective circumstances of a wild life of war and plunder or a tame life of peace and industry. That the neighbourhood of the nations of Old Mexico may have influenced the civilisation of the Pueblo tribes is likely enough, but Dr. Ten Kate argues on grounds both of skull-measure and language (pp. 265, 221) against any identification of Zuñis or Moquis with Aztecs. Indeed, it is the general experience of anthropologists, in spite of resemblances in such matters as the step-pattern on the pottery, that the language, customs, and religion which the natives of Zuñi or Tehua have preserved since the Spanish Conquest, show original and peculiar types which are not to be accounted for as borrowed from Mexico. Thus the designs on the earthen water-vessels, when explained, prove not to be copies of Mexican ornaments, but mostly direct symbolic pictures, a spiral for the whirlwind, a semicircle with descending lines for a rain-cloud, &c. This even affects the argument that the celebrated "cliff-dwellings" of the district were the strongholds of the ancestors of tribes such as the Moquis, who claim to continue and interpret the designs on their pottery (p. 265). Dr. Ten Kate had the good fortune of visiting Hualpé with Major Powell and seeing the Moqui snake dance (p. 242). He was allowed to go down the *estufa* to see the paraphernalia of the dancers and the vessel of drink taken as prophylactic against rattlesnake-bites, and his account of the dance itself, particularly as to the way in which the rattlesnakes are carried in the mouths of one set of dancers while another set by tickling them with feathers prevents their striking, is much in the same terms as that given by Capt. Bourke (see NATURE, vol. xxxi. p. 429). Mr. Cushing was still at the pueblo of Zuñi under his Indian name of Ténatsali or "Medicine Flower," and with his guidance Dr. Ten Kate had opportunities of studying the social life of the interesting matriarchal community. The main features of the family system are now clear, as to the young man being chosen by the young woman as "hers to be" (*yiluk'ianiha*) and his being taken by her father into the house as pupil (*talahi*); thus he passes into the position of a husband who can be sent back to his home, and the father of children who belong to their mother and inherit only from her. But in this and other accounts there are indications of what is evident to every traveller who has visited a Zuñi home—that the father after all has real power even in that matriarchal household. It is to be hoped that Mr. Cushing, when he gives the world his long-expected treatise on Zuñi language, manners, and religion, will be able to make the practical working of the matriarchal life more perfectly intelligible to the prejudiced patriarchal mind of the white man. Dr. Ten Kate inspected characteristic tribes throughout the New Mexican district, from these comparatively high Zuñis down to the low Utes, noting details of customs and other anthropological material which at times illustrate the effects of intercourse through a yet wider range of culture. Thus the wooden plough and creaking ox-cart of ancient Rome, introduced into America by the Spanish conquerors, are to be seen at work in the fields around the pueblos; and white men passing near an Indian cairn still throw each a stone upon it for luck (p. 271).

The well-known questions as to America before the time of Columbus may be counted on more than ever to arouse the interest of even the "general reader"—whether and how the natives came across from Asia, whether they made or imported the peculiar civilisations of Mexico and Peru, and so on. Thus it was quite worth while to translate the Marquis de Nadaillac's "Amérique Préhistorique," with its summaries of information and illustrations borrowed from the best sources. The work has been improved by being edited by Mr. W. H. Dall, whose own researches in the Aleutian region form one of the most interesting chapters in the anthropology of America. In the first place, the interesting though as yet hardly clear evidence is fairly given as to man's existence in America before the recent geological period. One of its most curious details is the description by Ameghino the geologist (p. 29) of his finding human remains on the banks of the Rio Frias, some twenty leagues from Buenos Ayres, associated with charcoal, potsherds, and stone arrow-heads, near the carapaces of gigantic extinct armadillos (Glyptodon) which had served as ready-made roofs to the pits in the ground which formed the dwellings of the ancient savages of the Pampas. It seems that, though the relater was a well-known geological explorer, his account was received with such incredulity, even in the district, that the Argentine Scientific Society refused to allow a paper to be read before them. The present volume, however (p. 477), contains particulars of a further discovery of the same kind, a human skull and most part of the skeleton having been found below an inverted Glyptodon carapace. This is not indeed conclusive, on account of the frequent displacement of the Pampas soil by floods, and even were the contemporaneity of man and Glyptodon made out, the upper bed containing the remains of this huge edentate may be more recent than the quaternary date. But no doubt there will be more finds, and it may help the discussion to point out that there seems nothing improbable in a man's living under a Glyptodon shell four or five feet long, inasmuch as there is classical authority for such habitations in the Old World. The natives of Ceylon, according to Ælian, could live under their great turtle-shells as roofs; so Pliny mentions the Chelonophagi of the Persian Gulf covering their huts with the shells of turtles and living on the meat. It is to be feared that the late Dr. Lund's researches in the limestone caves of Brazil, claimed as proving that the American man was a contemporary of the extinct megatherium and horse, were not made accurately enough to be relied on now, but it is well to keep them in view to encourage similar research. On the northern continent, Dr. Abbott's rude implements of argillite trap are the most remarkable objects claimed as the work of Glacial man, and they have proper description and drawing here, while every other discovery worthy of any consideration receives it. As is usual in French works, proofs of the high geological age of man are received somewhat more readily than in our more sceptical English literature. An unusually full account is given of the shell-heaps which fringe the coasts of both Americas, sometimes fifty feet thick and more, so as even to be valuable for the supply of lime to the builders of neighbouring towns. The high age of some of these rubbish-heaps is shown by elevation of the ground having lifted them high above the sea-level where the shell-fish were doubtless cooked and eaten, while the cannibal habits of the rude savages of the shores are shown by the usual evidence of human bones split for the marrow. Probably the more recent heaps are those characterised by tobacco-pipes, and stone pestles and mortars like those in which the modern Indians bruise seeds. This seems at least a reasonable opinion notwithstanding that such stone pestles and mortars have been put forward as evidence of man inhabiting California far back in the Tertiary period. M. de Nadaillac's chapters on the mound-builders and cliff-dwellers, and the nations of Mexico and Peru, give much popular information. The original French work discussed at some length the native American legends of deluges and other catastrophes, commemorating the mythic forefathers of nations and introducers of religious laws, and arts; but the American editor, with better judgment of the historical value of these tales, has pared them down, leaving the reader to form his judgments on more solid matters. Should a new edition of "Prehistoric America" be demanded, it will be well to have the press more carefully corrected. So well-known a living authority as Prof. Marsh figures as "March," and it is with an effort that one recognises the ancient Chinese emperor "Fo-hi" under the designation of "Fo-Fli." At p. 2[illegible] M. de Nadaillac yields to the common temptation of finding the name of the *Nahua* nation in the name of the country *Anahuac*, as if it meant "the country of the Nahuas by the water;" but this is grammatically impossible, and indeed the etymology of *A-nahuac*, meaning simply "near the water," is quite indisputable.

The interest felt by Americans in the antiquity of man on their continent is shown by the appearance of forged relics. The so-called "Lenape Stone" is one of the [illegible] perforated stones known as gorgets, common in Indian graves, but on it is scratched a rude representation [illegible] hunters attacking a mammoth. When it was produced Mr. Carvill Lewis at once called attention to the obvious point, that the mammoth is a palpable imitation of the [illegible] of the cave of La Madeleine, whereas the hunters are imitated from the childish modern American Indian pictures on bark or deerskin. The artistic power of the men of the mammoth-period is shown by its being [illegible] consciously conveyed through the hand of so stupid [illegible] copyist.

E. B. Tylor

## PHYSIOLOGICAL PLANT ANATOMY

*Physiologische Pflanzenanatomie im Grundriss dargestellt.* Von Dr. G. Haberlandt. (Leipzig: Wilhelm Engelmann, 1884.)

WHEN one recognises the immense importance [illegible] continually keeping before the student, the [illegible] that from whatever standpoint the plant is viewed physiological considerations must never be lost sight of, one cannot but welcome the appearance of Dr. Haberlandt's text-book on physiological plant anatomy, and is disposed to do so with more than ordinary favour, recalling those chapters on physiological organography which appeared some three years ago in Prof. Sachs' "Vorlesungen." The subject is one to which [illegible] Haberlandt has specially devoted himself, the present volume being in fact the most recent of a series [illegible] detailed publications. On this account it is not [illegible] prising to find that much of the subject-matter is [illegible] new, and that of the twelve sections into which [illegible] book is divided five have already appeared in the [illegible] in Schenk's handbook entitled "Die physiologischen Leistungen der Pflanzengewebes." Dr. Haberlandt's [illegible] on the present occasion is to publish as complete [illegible] account as may be, of the present history of the subject, and the great point upon which he insists, is that [illegible] whole anatomical structure and the mode of arrangement of the various tissues composing the plant, are simply [illegible] many illustrations of the phenomenon of adaptation [illegible] physiological needs.

The first two sections are devoted to the consideration of the cell and the formation of tissues. The third [illegible] of the tegumentary system, and as far as regards [illegible] epidermis special stress is laid upon Westermaier's discovery that the epidermal cells serve for the storage [illegible] water, in addition to their well-known protective functions

The important influence of cuticular wax and epidermal hairs upon transpiration is also discussed.

In Section IV. the mechanical system is considered. With much of the subject-matter of this section we have been acquainted since the appearance of Schwendener's classic "Das mechanische Princip;" but it is of interest to note that in the fungi, *e.g. Usnea barbata*, evidence exists of a mechanical tissue which in the higher plants takes the form of sclerenchyma, collenchyma, and bast. The absorptive system includes roots, rhizoids, and like structures; attention being also drawn to the absorptive tissue of the scutellum. This organ in *Briza minor* is peculiar on account of the pronounced development of the absorptive cells, and their striking resemblance to root hairs.

Section VII. deals with the assimilative system, and one is much struck by the marked manner in which the whole structure of the leaf illustrates the principles of which Dr. Haberlandt is the exponent. The pallisade layers are naturally regarded as being the chief seat of assimilative activity, and it is pointed out that the cells below these layers, which are of the nature of spongy parenchyma, and contain comparatively few chlorophyll grains, are distinguished by the remarkable manner in which they abut on to the pallisade cells. Their special function appears to be to conduct or absorb the products of assimilation, and to be the means of conveying them to other parts of the plant. They are in consequence designated as receptive or conducting cells (Aufnahme oder Sammelzellen). The infoldings which occur in numerous pallisade cells and are so well developed in the leaf of the various species of Pinus, have for their object the increasing of surface-area, and consequently also the number of chlorophyll grains in the cell.

Some space is devoted to the consideration of the conducting system, which includes the parenchyma of the cortex and pith, the medullary ray parenchyma, &c., the vascular bundles and laticiferous tissue.

Dealing with the vascular bundles from the point of view of physiological anatomy, a special terminology has been adopted. The whole bundle is known as the Mestom, the xylem as the Hadrom, and the phlœm as the Leptom. The idea of Mestom includes purely vascular tissue, and excludes the mechanical sclerenchymatous and fibrous tissue (stereom), consisting usually of prosenchymatous cells (sterëides), such as occur accompanying the bundles of most monocotyledons. Dr. Haberlandt's experiments demonstrate that in the moss stem the central strand of tissue is to be regarded as consisting of rudimentary hadrom, having for its function the conduction of water. To the layer surrounding the vascular bundle in roots, &c. (endodermis of De Bary) is applied the term "protective sheath," or "protective layer," on account of its function with relation to the bundle.

For a more complete understanding of the nature of laticiferous tissue we are again indebted to Dr. Haberlandt, whose observations upon this point appear to be of extreme importance. These observations demonstrate that in many of the thick-leaved Euphorbias, those portions of the laticiferous cells which enter the leaf become repeatedly branched in the leaf-tissue, and in such a manner that the extremities or blind ends of these branches abut directly on to the pallisade parenchyma cells, and are thus brought into the closest possible relation with the seat of greatest assimilative activity. The natural inference as to the function of laticiferous tissue has consequently everything to be said in its favour.

In Section IX. the intercellular space system is dealt with, and the various forms of stomata and their mechanism described. Much importance must necessarily be attached to this system when one bears in mind the relation of transpiration and gaseous diffusion to plant-life. The remaining sections are devoted to the secretory and excretory organs, and to the phenomena attending the normal and abnormal mode of increase in thickness of the stem and root.

The few remarks that have already been made are sufficient to show that the book contains numerous points of much interest. It is, moreover, carefully written, and furnished with a copious bibliography.

We cannot conclude this review without pointing out as Dr. Haberlandt has so fitly done, the importance of recognising that in every system there is not only the chief, but also the subsidiary, function, and that in considering any one of them which is especially significant, the less pronounced but still existing functions must be kept in mind. By such means alone will the true advance of physiological anatomy be maintained.

W. G.

## WILLIAM HEDLEY

*William Hedley, the Inventor of Railway Locomotion on the Present Principle.* By M. Archer. Third Edition. (London: Crosby Lockwood and Co., 1885.)

IN this little book the author endeavours to place on record more exact facts with regard to the invention of the locomotive, and to give prominence to the name of the man who first made the locomotive a practical and financial success.

Richard Trevithick is perhaps the only man, before Hedley's time, who narrowly missed the fame now accredited to Stephenson and Hedley. In 1808 Trevithick constructed a circular railway in a field, now forming the southern half of Euston Square. On this railway he placed a locomotive of his own construction, having flanged wheels, a tubular boiler, and a vertical cylinder, driving by means of a cross head the hinder pair of wheels. This engine was attached to a coach, and the few people who would venture in it were taken round the railway at so much per head. After running for a few weeks, a rail broke, causing the engine to leave the rails, and turn over on its side. At this time Trevithick had expended all his means, and was compelled to give up his endeavours to convince the public of the many advantages to be obtained from the use of the locomotive; had he been backed up by influential men, no doubt he would now be known to fame as its inventor.

Many men before Hedley's time had tried their utmost to make a workable locomotive, such as would supersede horses on a colliery railway. Trevithick, Blenkinsop, and Chapman all exercised great ingenuity in their designs, but success was as far off as ever, owing to the general idea prevailing that some mechanical connection must exist between the engine and the railway, believing that the mere adhesion between the smooth wheels and smooth rails was completely insufficient to prevent slipping.

In the year 1812 William Hedley was viewer at the Wylam Colliery, and in order to reduce the working expenses he endeavoured to construct an engine to haul the coal waggons from the colliery to the river, and to do it cheaper than by horse haulage. At this time he had a knowledge of what others had done in this direction, but was forcibly impressed with the idea that the weight of an engine was sufficient for the purpose of enabling it to draw a train of loaded waggons. After having made successful experiments to prove the idea correct, he set to work and constructed his first engine, which, when completed, did not prove a success owing to shortness of steam, and a second one was made. The second one, the well-known "Puffing Billy," was put to work in May, 1813, and was a complete success. This may be safely called the first practical and efficient locomotive ever constructed. It had a return-tube boiler of wrought iron, vertical cylinders, and was placed on four wheels. Very soon after the engine commenced to work the exhaust steam was turned into the chimney to create a blast on the fire. This engine worked nearly continuously until 1862, when it was bought, and has now found an honourable resting-place in South Kensington Museum.

Puffing Billy was put to work in 1813, nearly a year before Stephenson's first engine was tried at Killingworth in 1814, thus proving without doubt that William Hedley was the first man to construct the first practically successful locomotive engine, and the first economical substitute for animal power.

It should not be thought that our author claims for Hedley the fame of being the first to develop the railways. Puffing Billy was at work sixteen years before the celebrated Rainhill contest took place, and ten years before locomotives were allowed to work the goods traffic on the Stockton and Darlington Railway.

Stephenson's success may be dated from the Rainhill contest in 1829; and he was one of the first men to bring the present railway system forward and develop it. At the same time William James must not be forgotten; he surveyed the Manchester and Liverpool Railway before Stephenson was placed in charge of the Railway Works, and had it not been for a difference of opinion on certain technical points, William James would have been the engineer of the line until open for traffic. Again, William James went to see Stephenson's engine, before Stephenson came to Liverpool, finding him an intelligent working man and the engine a success, he brought Stephenson to Liverpool, where he eventually commenced his successful career.

The author is to be congratulated on having proved his case, and in the preface he truly says: "Without William Hedley, George Stephenson might have lived in vain. It was William Hedley who gave the locomotive its life and power, and made the work of other men possible."

The book is very interesting, and is useful as a book of reference, the appendix containing extracts from the opinions of many writers, and letters from men able to give information on the subject. This little book will prove useful to all who wish to know the facts concerning William Hedley and his inventions. N. J. L.

## 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. No notice is taken of anonymous communications.*

*[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]*

### Shotfiring in Mines

For some time past I have been conducting a series of shot-firing experiments at Dowlais and elsewhere on behalf of the Royal Commission on Accidents in Mines. Towards the end of August last Prof. C. G. Kreischer, of Freiberg in Saxony, visited me at Cardiff for the purpose of conferring with me on the coal-dust question. The experiments at Dowlais have a direct bearing on that subject, so, after pointing out to Prof. Kreischer the perfectly private nature of the investigation, and the delicate position in which I would be placed were the results allowed to transpire through any channel other than the Royal Commission, and having received his assurance that such a contingency was impossible as far as he was concerned, I asked him to accompany me to Dowlais, so that he might witness some of the experiments on August 28 and September 1.

On the second (?) day Prof. Kreischer asked my permission to write to his friends in Germany, suggesting that they might make a few similar experiments privately in an apparatus that had been set up at Zwickau, at the expense of the Saxon Government, for the purpose of conducting a series of experiments on coal-dust. He again assured me that no publication of results would take place until after those obtained here were made known, and offered, if I had the least doubt as to the integrity of his friends, not to put it in their power to anticipate our results by not writing to them at all.

I did not feel justified in resisting such an appeal to my good-fulness, and agreed to his proposal.

A few days ago I received the following letter, which I shall be glad if you will kindly publish, along with my answer.

Sir F. A. Abel is the inventor of the dynamite water-cartridge, and not myself, as might be inferred from the article in *Gluckauf*.

W. Galloway

*Freiburg*, October 2, 1885

Hochgeehrter Freund.—Es war mir unmoglich wieder nach Cardiff zuruckzukehren da wir uns zu lange im Dortmunder reviere aufgehalten hatten und die Zeit meiner zulassigen Reise in England sich allzusehr dem Ende zuneigte. Leider bin ich dadurch um das Vergnügen gekommen noch einmal mit Ihnen personlich verkehren zu konnen, doch hoffe ich, dass wir uns einmal wieder sehen, vielleicht in Zwickau.

Die Schiessversuche mit Wasserbesatz und Pulver—— Versuchsstrecke haben sowohl in Zwickau als auf Neunkirchen zu guten Resultaten in so fern gefuhrt als Gasen nicht entzundet wurden. Versuche mit Pulver Wasserbesatz in der Plauitzer Kohle ergeben aber in keine guten Resultate, als die Schüsse nicht werfen.

Leider hat Assesser Nonne, welcher den Versuchen beiwohnte, ganz gegen unsere Verabredung sogleich die Resultate der ersten Versuche in einer kurzen Notiz im *Gluckauf* veröffentlicht, jedoch ohne ihre Prioritat zu nah zu treten, da Sie besonders darin erwahnt sind. Ich hatte ausdrucklich vor jeder Publication gewarnt ehe die Ihrige nicht erschienen sei, ein solcher Character kümmert sich aber um so etwas nicht.

Bei späterer Veröffentlichung der Zwickauer Versuche kann eventuel darauf Bezug genommen werden.

Nochmals fur alle Liebe und Freundschaft, die sie mir vielfaltig erwiesen haben bestens dankend,

Verbleibe ich mit herzlichem Gluckauf,

Ihr,

Ergebenster,

C. G. Kreischer

Herrn Bergingenieur Galloway, Cardiff

*Cardiff*, October 9, 1885

Dear Professor Kreischer,—I have received your letter of the 2nd inst. I observe that the friends to whom you sent a description of the shot-firing experiments have violated the conditions under which I gave you permission to make your communication to them by already publishing their results in they were in some sort original. You mention as a kind of palliative that, although my priority is not distinctly admitted, my name is mentioned in a prominent manner.

Personally I consider this a very small affair. Long experience of having my name mentioned in a similar manner, or mixed up with the names of others, or altogether omitted in connection with certain coal-dust matters in which I have undeniable priority, has hardened me; and I confess that this part of your letter gave me no concern. But although I could afford to pass it over in this way as far as I am myself concerned, I cannot adopt the same course when the interests of some of the members of the Royal Commission on Accidents in Mines are also at stake.

I must therefore ask you to give me a token of your good faith by restraining your friends from publishing anything further until the English Royal Commissioners shall have seen fit to make known the results obtained here. At the same time also I would suggest it as a simple matter of duty on your part to take immediate steps to let it be known to those before whom your friends' communications have appeared that the credit, if any, of the original investigations in this case rests with Sir Frederick Abel and Mr. W. Thomas Lewis quite as much as with me. Believe me yours very faithfully,

W. GALLOWAY

Herr Bergrath Kreischer, Professor der Bergbaukunde, Freiberg, Sachsen

### The Resting Position of Oysters

IN books on Conchology, such as Woodward's "Manual of the Mollusca" and Jeffrey's "British Conchology," it is stated that the oyster rests in the natural state on its left valve, which is the larger and more convex. In this respect it is pointed out the oyster differs from the animals belonging to the genera Pecten and Anomia, which rest on the right valve, the Anomias being firmly attached by muscle with the flat right valve applied closely to the surface of attachment. In his lecture on oysters at the Royal Institution, which was published in Nos. 1 and 2 of the *English Illustrated Magazine*, Prof. Huxley also states that oysters rest on the left or convex valve, the flat right valve acting as a kind of operculum. Examination of oysters from the Firth of Forth has convinced me that this statement is erroneous. I do not know on what evidence the current belief of conchologists is founded. The evidence which appears to me conclusive is that the right flat valve is always quite clean, while the convex valve is covered with worm tubes, *Styela grossularia*, and Hydroids. The latter are in this connection the most important; it would be impossible for specimens of Sertularia and Thuiaria 4 or 5 inches long to grow, as I have found them on almost every oyster, in the central part of the left valve, if that valve were the lower in position. On examining Pectens I found that they resembled the oyster in the contrast between the surfaces of the two valves, the upper convex one being covered with Balanus and other fixed animals, the lower being almost clean. It is generally stated that the Pecten lies on its right valve; if this statement rests on the evidence afforded by the condition of the surface of the valves the same criterion applied to the oyster leads to the same conclusion, that the right valve is the lower. I have never seen a young oyster in the attached condition: Huxley states that it is the left valve which is fixed; in papers on the embryology of the oyster I have not yet been able to find any definite information on the point. Whether it is the right or left valve that becomes attached when the larva assumes the sessile condition I cannot therefore say of my own knowledge, but with regard to the adult oyster it seems to me certain that the current belief is caused by the repetition of an error. My attention was first called to this point by my assistant, Mr. John Walker, who tells me that the opinion of the fishermen at Newhaven is divided on the point, some saying that the convex valve, others that the flat valve, is the lower.

J. T. CUNNINGHAM

Scottish Marine Station, Granton, October 14

### Two Generalisations

Two generalisations seem to have been staring us in the face for some time, and yet I have seen no one give them a look of recognition; they may be phantasms, but they seem solid enough:—

(1) That the number of elements is infinite; th[illegible]ly formed types of ethereal vortices being the commonest, but our knowledge of them being only limited by the scarceness of the more complex forms, and not by any limit to the infinite varieties of complexity that may exist. Their relative commonness being analogous to the relative sizes of the bodies of the solar system; a few large, and always recognisable, and a greater number of examples as we descend in size to mere meteors. We already see that there are far more rare elements known than common ones.

(2) That the reduction of an electric current to heat in an imperfect conductor is solely due to the independent heat-motions of the molecules, which check and divert more and more of the current as their motions are larger; if there were no pre-existing heat-motions there would be nothing to resist a complete transmission of the current motion, and hence there would be no limit to conduction at the zero of temperature except the cohesion of the material.

Bromley, Kent W. M. FLINDERS PETRIE

### Meteors

ON the morning of October 13, at 2h. 26m., I saw a fine meteor giving a bright flash at the end point and leaving a streak for about 12 seconds. It shot from the Lynx towards the pointers in Ursa Major, and while carefully fixing its direction relatively to the stars near, another conspicuous meteor, about as bright as Jupiter, crossed the lingering streak in a path but slightly inclined to it and of nearly similar length. I have never before observed two large meteors almost simultaneous and with paths so nearly identical.

I subjoin the observed paths of these meteors, also of five other bolides recently noted here during the progress of my habitual watches for shooting stars:—

| 1885 | G.M.T. | Mag. | Path From | Path To | Length | Radiant |
|---|---|---|---|---|---|---|
| | h. m. | | ° ° | ° ° | ° | ° ° |
| Sept. 9 | 15 48 | ♃ | 149 + 82 | 152 + 64 | 18 | 335 + 71 |
| ,, 15 | 15 11 | ♃ | 37 + 6½ | 26½ + 7 | 10½ | 70 + 4 |
| Oct. 7 | 10 51 | ♃ | 51½ + 22 | 71½ + 24 | 18 | 31 + 18 |
| ,, 8 | 15 9 | ♃ | 155 + 53 | 162½ + 46½ | 8 | 42 + 55 |
| ,, 12 | 14 26 | ♀ | 119 + 51 | 151 + 60½ | 20 | 88 + 18 |
| ,, 12 | 14 26 | ♃ | 119½ + 50 | 143 + 60½ | 16½ | 103 + 33 |
| ,, 16 | 16 35 | ♃ | 213 + 47½ | 226 + 41 | 11 | 143 + 49 |

The radiant points are derived in each case by combination with many other meteors registered on about the same nights. I have seen 357 meteors since early in September, and those selected in the above table comprise all the brighter specimens estimated to equal Jupiter.

W. F. DENNING

Bristol, October 17

### Statigrams

THE increasing use of graphic representations of statistics by means of lines, areas, &c., seems to render it convenient to have some word which would specially designate diagrams exhibiting the progress and tendencies of the numerous tables of figures which do not pretend to strict scientific accuracy. The word *diagram* is used in most elastic senses and by all sorts and conditions of men.

May I suggest the word *statigraph* as a definite and convenient one for adoption? This might be sometimes shortened to *graph*; whereas *statigram*, if preferred, would not admit of this abbreviation. Most, if not all, graphic results of statists, economists, anthropologists, &c., might thus be termed *graphs*, whilst mathematicians and the experimental men of science would be left with the use of their own words, such as *curves, indicator diagrams*, &c. Each class would possess its own degree and limits of accuracy: mathematical precision and the doctrine of energy would apply to the latter, but *graphs* would be understood to involve human elements with intricate factors whose recognition or relationships the statistics are intended to elucidate and compare rather than to define and measure.

12, Merton St., Oxford J. F. HEYES

## THE GEOLOGICAL SURVEY OF BELGIUM

PROBABLY no country of Europe has had its geology more attentively studied and mapped than Belgium. From the early labours of the veteran and pioneer

D'Omalius down to those of Dumont and his contemporaries, the structure of this country has engaged the attention of many able observers, and in its broad features is now well known. The map of Dumont, on the scale of 1-160,000, is one of the most excellent geological representations of any part of the European continent. But a good many years have passed away since its publication, and though it remains essentially accurate, it is now capable of improvement as regards details. Accordingly, after many discussions of the subject, a Commission was appointed to undertake a more detailed and exhaustive geological investigation of the country. This Commission consists of five members of European reputation, viz., M. Brialmont, Inspector-General of Engineers, one of the most distinguished engineer officers in Europe; M. Maus, Honorary Director-General of Bridges, Roads, and Mines, who made the preliminary plans for the piercing of the Mont Cenis Tunnel; M. Stas, the well known chemist; M. Liagre, Perpetual Secretary of the Royal Academy of Belgium, who measured the geodetic base-line of Belgium; and M. Houzeau, Director of the Royal Observatory, whose writings on geological geography are widely appreciated. These able and thoroughly representative men of science were constituted as a Board of Control by which the operations of the Survey were to be governed, the practical carrying out of the work being placed in the hands of M. Dupont, Director of the Royal Museum of Brussels—a geologist of established reputation.

The work was begun in 1878 with the topographical map of the Engineer Department on the scale of 1-20,000th, or, roughly, about 3 inches to the British statute mile. It was estimated that the survey of the whole of Belgium on this scale would be completed in seventeen years from that date. This detailed map is divided into 430, or, excluding the frontier sheets, 369 sheets. Each of these is oblong in form, comprising an area of 10 × 8 kilometres, or 8000 hectares, or nearly 20,000 English acres. To produce upon this larger scale a map which should be only an enlargement and rectification of that of Dumont was very far from the object of the Commission. It was determined to adopt a monographic method of surveying. Each important geological system or group of formations has been entrusted to one or more specialists, who have given particular attention to its investigation, and who have been charged with the duty of tracing the same system or group completely across the country. Each geologist is furnished with two assistants who detach rock specimens, collect fossils, make borings, and in other ways save the time and labour of the officer under whom they serve. Every actual outcrop of rock is marked on the map, and where the rock is fossiliferous the fossils are noted and the various palæontological subdivisions of the strata are traced, the collector being afterwards sent back where more ample collections are thought necessary.

It was from the first determined that the detailed geological map should be not merely a scientific undertaking, but a work of as much practical utility as possible. Special attention was accordingly given to the soils and subsoils, and care was taken to express upon the map the variations in the agricultural character of the ground. For greater exactness in this respect a system of boring was adopted. A stout auger was constructed which could be thrust a yard or so into the ground and bring up samples of the soil and subsoil. This instrument is made use of at intervals of 100 metres along the lines of traverse, so that the variations in the superficial layers can be accurately noted.

To secure harmony in the work, each officer entrusted with the survey of a particular series [illegible] from time to time confers with his colleague[illegible]gaged on contiguous bands, and thus the [illegible] structure of the country is worked out [illegible]

Up to the present time thirte[illegible] [illegible]ted off, and many more are [illegible] engraving and preparation. It is believed that one-th[illegible] of the entire work of the survey has been complete[illegible] The ordinary topographical maps of the État-major ar[illegible] printed from zinc plates, and with their crowded con[illegible] lines and rather blurred printing are but ill adapted [illegible] the insertion of further geological details and the recep[illegible]tion of colour. The Commission of the Geological M[illegible] accordingly decided to engrave this map on copper adding new roads and other features, but leaving ou[illegible] non-essential topographical details. By this mean[illegible] admirably clear base has been secured for the delinea[illegible] of the geological structure, while at the same time copper plate engraving has been introduced as a new ind[illegible] into Belgium. Comparing the ordinary sheets with [illegible] geological equivalents we are struck with the great bea[illegible] and clearness of the latter. Even for every day [illegible]graphical use they are immeasurably superior.

One of the great problems of geological cartograph[illegible] how best to pourtray at once the superficial accum[illegible]tions and the solid rocks that lie underneath these. [illegible] this country it has been found practicable on the detai[illegible] six-inch maps of the Geological Survey to represent [illegible] surface-deposits by various kinds of stippling on [illegible] copper plates, the alluvia and the solid rocks being ex[illegible]pressed by tints of colour. On the one-inch maps, how[illegible]ever, which show the surface features by shading, [illegible] method cannot be employed. It has accordingly [illegible] necessary to issue two versions of each sheet of the [illegible] inch map—one showing the solid rocks, the other repre[illegible]senting the distribution of the various drifts and [illegible] detrital accumulations. These maps are coloured by [illegible] and are often of great beauty, but of course are somew[illegible] expensive, more especially as two editions are need[illegible] to complete the representation of each district. [illegible] Dupont deserves the admiration of geologists for [illegible] solved this difficult problem in an altogether novel [illegible] and for having produced a series of maps wh[illegible] will probably inaugurate a new departure in ge[illegible]logical cartography. His principle is to represent [illegible] the geological formations of a district, ancient as [illegible] as modern, upon the same sheet. As the superfici[illegible] accumulations extend across much the largest area [illegible] ground, they are shown by various broad washes of [illegible] over the tracts which they respectively cover. The[illegible] colours, though they necessarily spread over most of ea[illegible] sheet, are kept so subdued in tone that they do [illegible] interfere with the easy legibility of the stronger [illegible] employed to denote the underlying solid rocks. E[illegible] actual outcrop of these rocks is marked by a patch of [illegible] colour chosen for the particular formation. We [illegible] note at a glance the localities where the rocks of [illegible] formation can be seen at the surface. At these [illegible] signs are inserted to mark the dip, and any li[illegible] or palæontological subdivisions which have been [illegible] and regarding which a detailed legend on the sides [illegible] bottom of the map gives ample explanation. So far [illegible] map is merely a transcript of what is observed in [illegible] But it is of course necessary to express the limits of [illegible] several rock-groups. And it is here that M. D[illegible] ing[illegible] most remarkable. He shows these [illegible] do[illegible] dots varying in strength [illegible] th[illegible] the limit which they [illegible] st[illegible]ch stage ha[illegible] sh[illegible]racteri[illegible] bo[illegible] stages [illegible] colours [illegible] can thus [illegible] across the [illegible] actual expo[illegible]

As the maps [illegible] to secure ha[illegible] accuracy. We [illegible] [illegible] and what is [illegible] the data on which the geological boundaries have been traced, and can thus judge where and how far these are conjectural. We are not aware of any other published maps where this confession has been so frankly made.

The pale yellows and greys adopted for the superficial deposits cover so much of each sheet as to show at once how large a part of the ground is occupied by them. The detrital material is traced up to its source upon the table-lands, and being of poor agricultural value its colour on the map shows where farming operations are least likely to be successful. Where observations by boring or otherwise have been made on the nature of the soil and subsoil these are marked on the spot by the requisite sign, and as the borings are numerous these indications abound all over the map.

During the progress of the work improvements have been made in the methods of surveying and also in the modes of expressing geological details on the maps. In the Brussels area, for example, besides the ordinary borings into the soil and subsoil, deeper borings have been made to ascertain the nature and succession of the strata underlying the uppermost deposits. Messrs. Rutot and Van den Broeck, two of the staff, have invented an ingenious instrument with which they can ascertain the nature of the formations down to a depth of even 10 metres. By its means they have pierced below the subsoil in all directions, and have accurately traced out the areas of the younger deposits around Brussels. The results obtained by them at each boring are clearly engraved on the map; so that at numerous points all over the district the farmer, the water-engineer, the railway-contractor, the quarryman, and others can learn precisely through what layers they must pass in any cutting or excavation beneath the surface. By another ingenious device, the section of each artesian well at Brussels is represented on the map beside the position of the well, and so clearly that the succession of rocks bored through may be taken in by the eye at once.

Each sheet of this detailed survey is so crowded with information that to those who have been accustomed only to the ordinary style of geological map-making it may at first seem a little confused. But if any one will take the least trouble he will soon find that the confusion is only in appearance. No maps have yet been published in any country giving so large an amount of accurate information with such clearness and precision, and where the actual facts are kept so clearly apart from inference. These sheets are not wall-maps to be looked at from a distance, but detailed maps to be closely studied in the hand. And they will well repay an attentive study. There is probably no national Geological Survey in any part of the world which may not find in them some useful hint or suggestion for its own improvement.

On completion of the detailed survey it is part of the original plan to prepare a smaller or wall-map like that of Dumont. But such a map is hardly needed; at least its preparation can well stand over until the whole country has been surveyed in detail by the methods so well conceived by M. Dupont. But besides the maps, the work of the Belgian Survey has included the preparation of ample explanations illustrative of the maps. Each sheet is intended to be accompanied with an "Explication" giving the detailed structure of the ground, descriptions of the rocks, natural sections, lists of fossils, and all the information required as supplementary to the geological maps. A number of these memoirs have already been printed. Each of them contains fundamentally three [illegible]ons running N. and S. across the formations, which [illegible]ium have a general E. and W. strike. These [illegible] described in detail, and full local references [illegible] The books are well printed, and the coloured [illegible]ions are excellent, while a novel attraction is [illegible]rtion into the text of coloured engraved [illegible] localities.

None of the maps or explanations, though they have been ready for some time, have yet been published. They are to be seen, however, in some of the public libraries and museums in Europe. Belgium has every reason to be proud of them, and we trust that the delay in their publication will speedily be followed by the issue of the whole series now ready and by the completion of those in progress. It is impossible to over-estimate the practical utility of such a detailed survey in a country like Belgium. No time should be lost in pushing on and bringing to a conclusion a work which has been so admirably begun.

ARCH. GEIKIE

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## THE THIRD INTERNATIONAL GEOLOGICAL CONGRESS

THE third International Congress of Geologists, postponed last year on account of the spread of cholera in southern Europe, has just been held at Berlin. Each successive gathering has far surpassed its predecessors in numbers and in the representative character of its members, the numbers attending the meeting at Berlin being no fewer than 255. Of these of course the large majority were Germans, who mustered in all 163. Italy, however, furnished 18 representatives; Austria, 16; Great Britain, 11; France, 10; United States, 9; Belgium and Russia, 6 each; Sweden and Switzerland, 3 each; Norway and Holland, 2 each; Spain, 1; Brazil, 1; India, 1; Japan, 1; Portugal, 1; Roumania, 1. The meetings were held in the buildings of the Reichsrath, or Parliament, the large room set apart for the deliberations of the Congress being that of the Lower House of Representatives, and no little interest was taken by the foreign geologists in the names of the Members of Parliament inscribed on the backs of the seats. The door also was pointed out from which the great Chancellor emerges to launch his philippics against the contumacious opposition. But the *genius loci* inspired no flights of eloquence nor much disputatiousness among the geologists. The use of French as the language of discussion was no doubt one effective cause of silence on the part of many members who would otherwise only too readily have made themselves heard. Under such circumstances the Latin races have of course a considerable advantage over the Teutonic. One of the Berlin papers gave articulate expression to the complaint that in an audience nearly two-thirds of which were Germans, French should have been chosen, and great was the delight expressed by the German element in the Congress, when the Minister of Public Instruction, who officially welcomed the assembly, gave his eloquent and appropriate address in German. But by common consent, and with much good humour, though often with a disregard for the claims of grammar, idiom, and pronunciation that must have been infinitely ludicrous to the French-speaking members, the international official language was used throughout the proceedings.

The ostensible work of the Congress, which lasted nearly a week, may be divided into five parts. Of these the first in order of treatment and also of importance was the report of the Commission entrusted at the previous (Bologna) meeting with the preparation of a geological map of Europe. During the four years that have elapsed since the Congress determined to undertake this work, satisfactory progress with it has been made. The topographical outlines of the map have been completed and engraved, and the Commission were able to show upon the wall a mounted copy of the outline map. The materials necessary for filling in the geology have already been supplied for a large part of Europe, and it is expected that in the course of next year the work will be so far advanced that proofs in colour of many of the sheets of the map will be ready. There can be no doubt that the preparation of this great map is the most important and useful undertaking of the Congress. It is an eminently practical piece of work, with an attainable aim which unites the geologists of all European States in a common definite labour. The engraving and colouring of the map are carried on in Berlin. Judging from the present state of the engraving and from the scheme of colours adopted, we may confidently anticipate that the completed map will be a singularly clear and beautiful specimen of cartography, and will form a noble monument of international co-operation.

The second subject, to which the Congress devoted most of its time, was the unification of geological nomenclature. Reports had been received from different countries as to the names and classification of the various subdivisions of the geological record. But the wide differences of opinion expressed in these reports showed how little prospect there was that anything approaching to unanimity on such a subject would be reached by the Congress. It is to be feared, indeed, that the endeavour to unify stratigraphical nomenclature all over the world is more Utopian than practical. Nature is not everywhere uniform, and it seems almost puerile to strive after a uniformity of classification and terminology which has no counterpart among the rocks themselves. The Congress itself appeared to realise this, for it wisely postponed the consideration of all questions about which there could be any serious differences of opinion, and adopted only those propositions which nobody would controvert, and which hardly required an international congress to settle. Thus it was agreed that the Archæan rocks should be divided into sections according merely to petrographical characters and without expressing any opinion as to their relative age. The vexed question of the Cambrian and Silurian classification was postponed until the next Congress three years hence. A day was spent in discussing the position of the Permian system, with the result of leaving it for the present where it is usually placed. The subdivisions of the Mesozoic and Tertiary rocks were rapidly enumerated, but no discussion of them was possible in the time. In truth, it is difficult to see how any real effective discussion of these subjects can be attempted at the ordinary meetings of the Congress. The assembly is so large that probably only a fraction of the audience is really competent to express an opinion on the particular subject under debate. Some of the members who might contribute most valuable suggestions are deterred from so doing by their timidity in the use of the French language. To count the heads of so miscellaneous an audience and say that such and such are the decisions which it has voted can really carry little weight with the geologists of the world at large. Such at least was the opinion freely expressed among the members at Berlin. There was a very general feeling that the less the Congress attempts in the way of authoritative decision or legislation the more likely is it to carry on effectively other functions which are of far more general importance and usefulness.

Thirdly, the reading of communications on geological questions of general interest. Several good papers were read, but the thinned audience showed that this part of the programme was not very popular. There seemed to be no careful selection of papers, for some of those that were read hardly deserved a hearing before an international gathering of geologists. If this section of the proceedings is retained, it might be well to invite beforehand a few men of acknowledged reputation to give discourses, each on his own subject. There would be a strong desire to hear the masters of the science, and if three or four of them of different nationalities could be induced to accede to this proposal, there would be no need for catering among the rank and file of the assembly for papers to fill up the time.

Fourthly, an exhibition of geological maps, sections, specimens, and models. This collection was arranged in the room of the Bergakademie, and proved a source of much interest and instruction. The series of national geological surveys represented on the walls embraced a large part of Europe, and included some admirable examples of cartography. Among the specimens special attention was given to those exhibited by Mr. Reusch, showing Silurian fossils in the crystalline schists of Norway, those of Dr. Lehmann illustrating his work on metamorphism, the wonderful group of amphibian remains shown by Prof. Credner, the series of fossils brought by Dr. Torell from the Primordial and Lower Silurian rocks of Sweden, various collections from different localities among the Cretaceous rocks of Germany, and a remarkable assemblage of specimens of northern rocks and fossils from the drift of North Germany, exhibited by Dr. A. Remelé.

Fifthly, excursions to places of geological interest. At the close of the Congress a large number of the members proceeded in a special train to Potsdam, and spent a day seeing the sights of that royal demesne. Next morning they started for Thale in the Harz, whence, under the able guidance of Prof. Lossen, they were enabled to see some of the more interesting features connected with the protrusion of the granite and the metamorphism of the surrounding rocks, likewise the succession of stratified rocks up to the Chalk, thrown against the flanks of the Harz. From Thale the party travelled to Stassfurt, and descended into the salt mines, which were illuminated in its honour; thence to Leipzig, where Prof. Credner acted the part of host and guide, and from which an interesting excursion was made into the Saxon granulite region.

But it is not by its formal and ostensible proceedings that the usefulness of the Congress is to be measured. There was a widespread feeling which constantly found audible expression, that the opportunities it afforded for personal intercourse and exchange of views were alone sufficient to justify its existence and to give assurance that it would long continue. The discussions among the animated groups in the corridors and ante-rooms were much more vivacious and probably quite as conclusive as those held in the large room. But most useful and enjoyable of all was the nightly *Kneipe* held in some beer saloon. There in a thick and pungent atmosphere of tobacco-smoke, amid the clattering of beer-jugs and shoutings for the *Kellner*, many of the foremost geologists of the Congress gathered together — stratigraphers, petrographers, palæontologists, mineralogists — full of scientific enthusiasm and good fellowship. Loud and long were the debates in these dim retreats. Tongues that had been shackled by French articulation now found themselves free in the unrestrained vernacular of their country. There were no reporters of course, and no record remains of the discussions. But the recollection of these evenings will not soon pass away from the memory of those who took part in them. Men from distant parts of the world who had only known each other's writings, or at most had exchanged letters, were here brought face to face, and the foundations of many a pleasant and profitable friendship were doubtless laid.

Great praise is due to the organising Committee in Berlin, and especially to its indefatigable General Secretary, Herr Hauchcorne, for the arrangements made for the business of the Congress and the comfort of the visitors. Every detail seemed to have been carefully planned, and the result was evident in the smooth working of the whole machine. It was a great gratification to see the venerable Dr. Von Dechen presiding over such an assembly of geologists, and to hear his reminiscences of the early days of European geology. The *bonhomie* of the President, Prof. Beyrich, put everybody in good humour, and the active guidance of the former President, Prof. Capellini, contributed largely to the success of the Congress.

The next session of the Congress is to meet in ...

between August 15 and September 15, 1888, and Messrs. Blanford, Geikie, Hughes, and Topley have been nominated a committee to make the necessary arrangements.

## BOTANICAL EXPLORATION OF THE CHILIAN ANDES

WE are indebted to the Kew authorities for the accompanying extract from a letter dated August 21, 1885, addressed to Sir Joseph Hooker by Dr. R. A. Philippi, the Professor of Botany at Santiago:—

"My son made in the summer during 110 days a voyage from Copiapo to the River Camarones, the actual boundary between Chili and Peru. He went first from Copiapo to Antofagasta de la Sierra (26° 5' lat., 27° 20' long., 3570 metres above the sea), where about 60 to 100 people are living, and thence (nearly always on the high table-land of the desert at an elevation of 3500 to 4200 metres) to Huasco de Tarapacá, from whence he descended to the tamarugal. The voyage extended over 8 degrees of latitude. This high table-land is nearly a single bed of trachytic lava, on which are scattered a number of extinct volcanoes, three of which are higher than Chimborazo—viz. the Llullaillaco, 6600 metres (I was, twenty-one years ago, at its west foot); the Tuniza, 6540; and the Pular, 6500 metres. There are many large salt lakes, several entirely dry. The vegetation in this easterly part of the desert is not so scanty as in the westerly, visited formerly by me, perhaps owing to a slight influence of the trade wind; and the water-places are more numerous and nearer one to the other.

"The number of species of plants brought home exceeds 400, of which half are not described. Amongst them is one *Polylepis* (without flowers), found only in one quebrada, and *Pilostyles Berterii*, a parasitic plant belonging to the same family as *Rafflesia*, found at the height of 3700 m.!—of course on an *Adesmia*. The three species of ferns are: *Pellæa ternifolia*, *Cheilanthes micropterus*, and a beautiful *Cincinnalis* which seems to be new. The most numerous family is, of course, Synanthereæ, with 94 sp.; Gramineæ has 42 (among them a new species of *Munroa*); Leguminosæ, 28-29; Verbenaceæ, 15; Solanaceæ, 28; Chenopodiaceæ, 15. Amongst these plants nine or ten must form, in my opinion, new genera. Some are very curious, as a Verbenacea, which grows in small hemispherical tufts and has the aspect of a Synantherea, with sessile flowers and pappus. This pappus proved to be a deeply-divided calyx with long cilia. There is another genus which I took at first sight for a *Tribulus*. I hope that my age, my health, my eyes, and my time will allow me to draw up the generic diagnosis, at least, of these plants."

## KRAKATAÖ

THE publication of the first part of Verbeek's "Krakataö," which chiefly contained the *history* of the great eruption of 1883, had raised many expectations regarding the promised description and discussion of the *phenomena* then observed. In his completed work, which contains 25 coloured drawings and 43 large and small maps, those expectations are fully realised. Immediately after the great outburst of August, 1883, the Dutch Indian Government sent him to visit Krakataö and to investigate the causes and effects of this awful catastrophe, more sudden and destructive than the famous eruption of Vesuvius. The great facilities they placed at his disposal enabled him to do this in the most satisfactory manner, and the really beautiful character of his completed work reflects the greatest credit not only on the learned author, but on the zeal and public spirit of the Dutch-Indian Government, who have aided him in making so valuable a contribution to scientific knowledge. So much interest has been taken by the general public, as well as by men of science, in this remarkable eruption, that we feel certain they also will welcome this volume, since it is lucid in style and profusely illustrated. With an expression of his gratitude to various institutions and individuals who have rendered him valuable assistance, the author gives in the preface a list of the weights and measures, together with a summary of the most recent ideas that geological science has received from the Krakataö eruption.

Krakataö itself lies on the point of intersection of three fissures or cracks in the earth's crust, and from this position is naturally exposed to volcanic disturbances. The earthquake of September 1, 1880, which damaged the lighthouse on Java's First Point, probably affected the Sunda fissure and facilitated the entrance of greater quantities of water into the volcanic furnace underlying the Straits of Sunda. Accepting the theory that volcanic eruptions are caused by steam at high pressure, we have thus the probable explanation of the terrible outburst of 1883. From the observations of earthquakes in the Indian archipelago during the year 1883, it appears that the eruption was neither preceded nor accompanied by heavy shocks. It is even far from certain that any trembling of the surface took place at the time, since the vibration of the air caused by the explosion was sufficient to shake houses and crack walls, and thus might easily have been mistaken for earthquakes. The author further treats of the ejected materials; their thickness, which, on some parts of Krakataö, amount to 60 metres; their size, varying from bodies of one cubic metre to the finest dust; the velocity with which they were thrown out, which must have been considerably greater than that of projectiles from the heaviest rifled ordnance; the elevation which they reached has been calculated at 50 kilometres, or nearly six times the height of Mount Everest, the highest mountain of the world, and the ashes have fallen over an immense area. From investigations made at fifty different places regarding the thickness of the fallen ashes and also the change in the depth of the sea around Krakataö, M. Verbeek has calculated that at least 18 cubic kilometres of matter must have been ejected. To give an illustration: imagine a box of ashes as large as Hyde Park and as high as the dome of St. Paul's, a hundred such boxes will give an idea of the mass of matter thrown out by Krakataö in 1883.

For three days after the eruption various ships to the westward found ashes falling on their decks; the names of these ships are given, as well as a map showing their exact position at the time. Mr. Verbeek believes that the finest particles, forced by the steam into the upper air, did not descend, but were carried westward by strong east winds, making twice the circuit of the earth and causing the phenomena observed at various places of a blue and green sun and moon. The passage of this cloud has been reported from islands and ships in the Pacific Ocean and its velocity must have been as great as that of a hurricane. After the steam and dust-cloud were dispersed over a wider area the beautiful red sunsets occurred, which were owing to the presence of such a large volume of aqueous vapour, while the blue and green colours of the celestial bodies were caused by the solid particles in the air.

The author goes on to elucidate the geology of Krakataö by two maps and four very instructive sections, showing its development during that number of periods. The first period was marked by the destruction of the great cone, probably 2000 metres high; during the second period the peak Rakata was formed by a lateral eruption, while in the third period two parasitic cones, Danau and Perbvewatan, were added, and these, by their successive eruptions, built up the island of Krakataö. In the fourth period two of these cones have been destroyed by the terrible eruption of 1883. As our authentic records of Java only date back 300 years, we have absolutely no data respecting anything that occurred in the first three of these periods. We have accounts of an eruption of the Perbvewatan in the year 1680 from two travellers—Vogel and Hesse—to which I drew attention in the *Algemeen Dagblad van Ned. Indie* of May 23, 1884; but they say nothing as to whether that crater was formed at that time or had been already active. After a rest of 203 years the Perbvewatan became again active in May, 1883, and the Danau joined it in activity during the following June, forming the principal crater in the centre of the old volcano. In August, at the great eruption of the 27th, this part of the volcano was again destroyed; the Perbvewatan and the Danau, with the northern half of Rakata Peak, disappeared, and the site of the old crater is now covered by the sea between the islands Lang, Verlaten, and Krakatab.

If the volcano resumes its activity, which is to be expected since the island lies on such a favourable point for eruptions, then small islands will appear between the three already mentioned. Krakatab has been at rest since 1883, although it has erroneously been reported to be active. The roll of thunder and the flashing of lightning over the ruins of the crater wall have been mistaken for the action of subterranean forces, while the volcanic dust swept off from the crumbling summit by the wind appears at a distance like smoke.

A very curious and interesting feature of the recent eruption of Krakatab was the ejection of fragments of underlying sedimentary rocks. The base of the Krakatab volcano, and in general the entire bottom of the Straits of Sunda, consists of eruptive rocks of the miocene period covered with horizontal layers of diluvial and recent marine deposits, the materials of which have been derived from the various volcanoes in the vicinity.

The first volume of Verbeek contained a valuable report from his colleague, Mr. J. A. Schuurman, on the phenomena of the eruption of May, 1883, as observed by himself, and the second volume has a lengthy and minute description by the mining engineer, Mr. J. W. Retgers, of his microscopical examination of the ash which fell at Buitenzorg, and of the various substances thrown out by the eruption of 1883, as well as of the older rocks.

A portion of the pumice which covered the sea after the eruption was carried westward by winds and currents and driven on the shores of various islands, even so far as the east coast of Africa. Another portion, which floated in the bays of Semangka and Lampong for several months, being driven in the beginning of 1884 by westerly winds along the coast of Java toward the Moluccas and Australia, is at present encountered in the Pacific Ocean between the Caroline and Marshall Islands. The author has calculated that this pumice will arrive on the west coast of America at Panama early in 1886.

With regard to the spherical bodies of a calcareous and clayey nature, called "Krakatab marbles," found lying loosely on the surface, Mr. Verbeek at first supposed them to have been formed by the rotary motion of particles ejected from the volcano, but as they were afterwards found imbedded in ejected fragments of claystone and marls, this theory must be given up; he considers it possible that there may have been concretions in the tufa, although their presence in rock sometimes quite destitute of lime is certainly surprising, and this form of concretions has not been observed hitherto.

The chemical analyses of the rocks of Krakatab can be fully relied upon, as they have been made by Dr. Cl. Winkler, Professor of Chemistry in the well-known Mining School of Freiberg, in Saxony. Dr. P. J. van der Stok, Director of the Meteorological Observatory at Batavia, proves that the disturbance in the position of the magnetic needle observed during the falling of volcanic

dust was *due*, not to the eruption, but to the
magnetite therein, since the
the shower of ashes.

The low temperature observed at
Buitenzorg, Kroe, Moeara-Doea, Bandar
was not due, according to hygrometric
the evaporation of the humidity of the
volcano and on ships in the vicinity
hot, but the ashes thrown into the
upper air and falling at a distance from the
become cooled in their passage. Heavy
charges occurred continually in the air
Krakatab. On Java's First Point and
lighthouses were struck by lightning.

On Sunday, May 20, 1883, all Batavia
commotion as to the cause of the mysterious
detonations which apparently came from the
fact did come from Krakatab. At Serang
which are situated much nearer to the volcano
had been heard. Again at Batavia on the
Monday, August 27, after the tremendous
8h. 26m., the eruption seemed to have ceased.
nothing at all of another enormous explosion
place between 11 and 12, as reported from
East Java. The explanation of this curious
is that earlier in the morning an ash cloud like a
lamp-shade settled over the volcano, extending
Bandong, and that the quantity of these ashes
floating in the air prevented the transmission
Above the ash cloud the detonations were
all directions, but naturally were most
to the windward. The farthest points where the
have been heard are Dorch, in New Guinea,
of Central Australia, among others the telegraph
of Daly Waters and Alice Springs,
Rodriguez and Ceylon. Accounting for the
time and taking the rate of transmission
author has calculated for different places which
detonation in particular has been heard.
of Monday morning, 5h. 30m., has been heard
that of 10h. 2m. a.m. has been heard at Banca,
west coast of Borneo, the southern and eastern
of Borneo, Bawean and Banda; that of 10h.
Riouw, Middle and East Java, Bali, &c.
detonations have not been noticed at Batavia and
zorg. The area within which the explosions have
heard is represented on a map; it amounts to
fourteenth of the whole surface of the globe—
extraordinary transmission of sound over so large
From the vibration of the air caused by the
tonations houses, doors, windows, clocks which
against the walls, objects which stood on cabinets
suspended from the ceiling were set trembling,
swinging movements given to hanging objects
quakes have nowhere been observed. That
have been cracked, and houses been damaged
no longer habitable, can be accounted for,
the author, by the probability that they were
weak, and thus had an opportunity of showing it.

The greatest air-disturbance caused by the
has transmitted itself as a regularly moving
wave, with Krakatab as centre, over the whole
to the discussion of this entirely new phenomenon
author has devoted about seventy pages. With
assistance of very accurate barograms from
N.S.W., he calculated the heaviest explosion
at 10h. 2m. a.m. Krakatab time. The same result
arrived at by another calculation based on the
of the indicator of the gasworks at Batavia.
cator marked fifteen oscillations, corresponding
many explosions, of which the four severest occurred
the forenoon of Monday, August 27,
6h. 44m., 10h. 2m., and 10h. 52m., Krakatab
Of these four, that of 10h. 2m. a.m.

greatest, and it is probable that the air-wave then formed made the tour around the world. Forty places in Europe, America, and Australia are named where the disturbance of the air has been indicated by barometers, and with the help of these data the author has been able to calculate the velocity of the air movement, which has been found to be considerably less than the velocity of sound at 0° C.; consequently the movements took place at a great height and in cold-air strata.

According to the author's calculation this air-wave required 35½ hours to make the circuit of the earth; it would have been of great interest to know just when the wave returned to Batavia, but, unfortunately, the diagrams of the indicator at the gasworks that might have marked such a return have been lost.

Part of Chapter V. treats of changes in the sea-bottom. The sea now covers to a depth of 200 to 300 metres what was formerly the northern part of Krakatão, and the small island called Polish Hat has also disappeared. Between the remaining islands, which are fragments of the old crater ring, an area has subsided of at least 41 square kilometres, or about 10,000 acres. Outside these islands, within a triangular space of 34 square kilometres, the sea is also deeper than formerly, so that altogether a surface of 75 square kilometres has subsided, which is clearly shown on maps 1, 2, and 4.

The part of the Peak which has disappeared must have been 1 cubic kilometre in size, and the fall of such a mass into the sea is quite sufficient to cause the great sea-wave which swept away thousands of human beings. Nowhere is there the slightest vestige of any upheaval, from which we may be certain that no seismic movement of the sea-bed has occurred. In Bantam and in the Lampong districts, after the disaster, the remains of the macadamised roads along the coast were everywhere as high above the sea as before, and soundings in Sunda Straits showed that no change of sea-bottom has taken place there. The shallower depth in the immediate vicinity of Krakatão, and between Krakatão and Sebesi, has probably been the result of fallen materials, to which also the islands Steers and Calmeyer, which have since disappeared, for the greater part, no doubt owed their existence.

As the last of the phenomena which accompanied the eruption of 1883, the movements of the sea are discussed, as shown by the destructive waves which have made this catastrophe so terrible. It is certain that the greatest wave of all started from Krakatão at 10 a.m., and that wave completed the destruction of Telok Betong, Anjer, and Tjiringin. This great wave had been preceded by small waves on Sunday afternoon at 6, and Monday morning at 6h. 30m., by which these places were already partly submerged and destroyed; but the really very remarkable phenomenon was observed that not every wave reached all the places situated along the coasts of the Straits of Sunda. For example: the wave which destroyed on Monday morning, at 6, a part of Anjer, and at 6h. 30m. the lower part of Telok Betong, has not been noticed at Tjiringin. The author explains this by the [illegible]pposition that the preceding waves were not caused by [illegible] falling in of parts of the volcano, but by the enormous [illegible]tities of ejected matter that splashed into the sea. [illegible]n Sunday evening during the eruption of 5h. 7m. [illegible]tity was thrown out on the spot where Calmeyer [illegible] thus formed was noticed everywhere around [illegible] Tjiringin, Beneawang, Telok Betong, [illegible] during the eruption on Monday [illegible]atter was thrown down on the spot [illegible] wave would be obstructed in a [illegible]lmeyer, and Tjiringin, lying [illegible] the wave would roll to [illegible]ttle after 6 a.m. In [illegible]orning (6h. 44m.), [illegible]Krakatão, and

Telok Betong by Lagoendie, whilst Beneawang in the Bay of Semangka was nearly destroyed; but the wave of 10 o'clock being of such enormous magnitude, swept over all obstacles.

Most careful calculations fix the time of the formation of the great wave at 10 a.m., the same hour at which the heaviest detonation was heard, so that the ejection of a stupendous quantity of ashes, pumice, and mud, the rushing in of the sea upon the mass of glowing lava, and the falling in of half the mountain, must have taken place almost simultaneously. From the height registered by the tide-gauges at Tandjong-Priok on Monday at 7h. 30m. p.m. it is evident that Batavia narrowly escaped a second inundation. The data collected from all parts of the world regarding an extraordinary movement of the sea soon after the eruption, made it possible to compute the velocity of the great wave, and this velocity enabled the author to calculate the average depth of the sea along the path the wave travelled. In this way he has ascertained that the depth of the sea between Krakatão and South Africa must amount to 4200 metres; between Krakatão and Rodriguez, 4560; and between Krakatão and South Georgia, 6340 metres; which shows that west and south-west of Australia there must be a deep-sea basin, the existence of which has not yet been revealed by soundings. Mr. Verbeek considers that, if the irregularities of the tide noticed at Aspinwall happened at the hour reported, they were not caused by the Krakatão wave, but by volcanic activity in the Antilles; that wave, however, was observed on the coast of France, at San Francisco, and even in Alaska. Its velocity was so great that it reached Aden in twelve hours, a distance of 3800 nautical miles, usually traversed by a good steamer in twelve days.

It is greatly to be regretted that our knowledge of this phenomenon beyond the Indian Ocean remains incomplete, on account of the small number of tide-gauges on the Atlantic and Pacific coasts; the author suggests that this want shall be promptly supplied, so that in future no important movement of the sea shall escape notice.

Chapter VI. is devoted to a consideration of the volcanic phenomena which have been observed during the eruption of Krakatão at other places within or beyond the Indian Archipelago. Simultaneously the volcano Gœnong Api, on the island of Great Sangi, the Merapi on Java, the Merapi on Sumatra, and also, it is supposed, a volcano in the Moluccas were in activity. A seismic movement of the sea-bottom occurred in the whole region of the Moluccas, which could not have been due to Krakatão, and this movement has been noted by three tide gauges in the Straits of Madura. Over a large part of Australia, from August 27 to 29, more or less serious earthquakes were felt—a phenomenon the more remarkable because Australia suffers very seldom from any shaking of the earth. It is probable that sudden displacements of steam—perhaps of lava—occurred in the subterranean cavities, caused by a change of pressure through the great discharge of lava and steam at Krakatão. We must therefore conclude that the underground recesses between Krakatão and Australia are in some way connected, so that any change of pressure in one cavity causes a change of pressure in the other.

Even at points in the neighbourhood of the antipodes of Krakatão shocks and volcanic effects were noticed, and if, as is probable, some point in the Antilles was in activity, then evidently the whole surface of the earth during the terrible discharge of Krakatão was agitated, and apparently the crust of our earth is not so solid as many of its inhabitants fondly imagine.

The author maintains the doctrine that part of our globe remains still in a molten state, and he disputes the theory, which has been advanced, that the heat of the volcanic furnaces is entirely due to local chemical action. He, however, acknowledges that it is very difficult to explain why, during the Krakataŏ outburst, the antipodes was more favourably situated for an eruption than the other volcanic regions of the earth. A similar tendency during former eruptions has not been recorded, and we must wait until another great outburst enables us to decide whether it is of any importance.

The coloured drawings, twenty-five in number, are all by Mr. Schreuders, who accompanied Mr. Verbeek in October 1883, and give a faithful picture of the devastated regions as they appeared two months after the eruption. The most striking picture is that of the stupendous wall, 832 metres high, which was laid bare by the destruction of the northern part of the peak. No one who has gazed upon this grandest of nature's ruins can forget its solemn desolation.

The careful typographical execution of the work reflects great credit on the Director of the Government Printing Office at Batavia. We can heartily congratulate the learned author on the successful completion of his most valuable and exhaustive work, interesting alike to the scientific and general reader.

## ON THE COLOUR-SENSE

THERE is an interesting paper in the *Nineteenth Century*[1] for February last in which the colour-nomenclature in the Homeric poems and that of the modern Hindústání language are compared with modern English usage. The writer traverses to a great extent Mr. Gladstone's suggestion[2] that the ancient Greeks were deficient in colour-sense (*i.e.* compared with modern Englishmen), and propounds the idea that the natives of India have a keen colour-sense.

It will be shown below that the use of colour terms in modern English is not only loose, but even incongruous. Illustrations will be taken from both the papers referred to, with additions from the author's experience in India.

*Natural Objects.*—Uniformity might surely be expected in the use of colour terms with bright-coloured natural objects. There is, however, no uniformity in their use, even when intended to be real colour designations; and opposite and sometimes unnatural colours are—in a figurative sense—ascribed to a single object.

Thus the colour of fresh blood and the tint arising therefrom in the healthy cheek and also in the blushing cheek (of a fair person) are probably among the most well-marked, definite, natural colours. Yet the blood itself is styled *blood-red*, *gory*, *crimson*, *red*, *scarlet*, whilst the healthy cheek is described as *carnation*, *vermeil*, *red*, *ruddy*, *rosy*, and *pink*, and the blushing cheek as *scarlet*, *crimson*, *red*, *aflame* (perhaps rather a heat than a colour term). These terms, though used as real colour designations, are by no means synonymous, whilst in a figurative sense quite different and even unnatural colours are ascribed. Thus *blue blood* is used of aristocratic descent, *black blood* and *white* or *pale blood* of descent from dark or fair races.

Again, healthy bile is bright yellow, and a yellowish tinge in the "white" of the eye is often called a *bilious* colour; yet in the figurative sense black is ascribed to the condition known as *melancholy*, *atrabiliousness*, *black bile*.

The colour of good milk is so characteristic as to give rise to the term *milk white*, whilst skim-milk or poor milk which has merely a blueish tinge is styled *sky-blue*.

Again, the parts of the human eye and of a bird's egg styled from their characteristic tint the *white* of the eye and the *white* of an egg, always bear the *name* of *white*, although occasionally of a decidedly blueish tinge, [illegible] than that of skim-milk.

Colour is usually ascribed to the human [illegible] the tint of the iris, probably as being the part most subject to colour-variation—*e.g.* *black*, *dark*, *pink*, *brown*, *hazel*, *green*, *blue*, *gray*, *light*. Of these, *black* is loosely applied (*e.g.* in the phrase *black-eyed*) in the case of any dark-coloured iris, whilst *green* and *blue* are used in the case of a mere tinge of green or blue.

On the other hand the phrase *red eyes* indicates either redness of the eyes (as from weeping) or a bloodshot state of the "whites," whilst a *black eye* implies only a dark-coloured bruise of the skin near the eye; *green in the eye* is a figurative expression implying freshness or ignorance, and *green-eyed* is a condition ascribed to jealousy.

The colour of sea-water varies from greenish (aquamarine) to a deep blue (ultramarine); but a wide range of colour-names is applied to various seas—*e.g.* the *Black Sea*, *Red Sea*, *Yellow Sea*, *White Sea*, and this in many languages.

The colour of river-water varies from turbid yellow to blueish and colourless; but in this case there is an equally wide range of colour-name—*e.g.* *Blackadder R.*, *Blackwater R.*, *Red R.*, *Orange R.*, *Green R.*, *Blue R.*, *Blue Nile*, *Grey R.*, *White R.*, *White Nile*, *Whiteadder R.*

*Human Colouring.*—Colour-terms, applied to races of men, or to the complexion or hair, are loosely used to cover a wide range of colour. Thus *black*, *dark*, *dusky*, *swarthy*, and *nigger* (*lit.* black), are applied to any merely dark skins; *red* and *coppery* to the whole of the North American (so-called) Indians; *white* and *pale* to any fair skin. The terms *dark* and *fair* (shade- rather than colour-names) are loosely applied both to the complexion and to personal description. Thus any complexion darker than the average in a fair race, or fairer than the average in a dark race, is called *dark* or *fair* respectively; the two terms being merely *relative* in this usage.

Also among a fair race, a person with dark eyes and dark hair is called *dark*, and one with light eyes and fair hair is called *fair*, without reference to complexion. Again, the terms *red*, *carroty*, *fiery* are often applied to hair which has merely a reddish tinge.

Among races of different complexion in the same country curious figurative usages of the racial colour-terms arise. Thus *nigger* (*lit.* black), *black*, *dark*, *redskin* are sometimes used by a (ruling) fair race to denote inferiority, and this usage is sometimes adopted even by the (ruled) dark race—*e.g.* occasionally by both negroes and natives of India. There is a curious restricted use of the phrase *gorá log* (*lit.* fair people) in India to denote the British soldiery, but not the higher classes of English.

*Animal Colours.*—Colour terms applied to animals have sometimes a technical meaning quite different to the fundamental colour. Thus *bay* and *strawberry*, as applied to horses, are very different colours from those of the bay-leaf and strawberry; thus also the Hindústání term *sabz*, usually meaning green, denotes *gray* when applied to animals. Again, *red* is applied to animals—*e.g.* cows, deer, foxes, squirrels, &c., whose coats are any sort of reddish-brown. A similar usage occurs in the Homeric poems—(*e.g.* φοινιξ and its derivatives), and in the Hindústání word *lál* (*lit.* ruby).

Colour-terms are sometimes applied to animals, plants, &c., even when only slightly affected with the named colour, to indicate a particular variety of the object in question. Thus a *blue* pigeon, fox, or rabbit, is only slaty blue; a *white* elephant is only spotted with white pink patches; a *blood* orange may be only speckled with blood-markings; a *black lion* and *black* leopard are only dark with black markings. Colours differing from nature are also ascribed to animals on signboards—*e.g.* [illegible] [illegible] thus also *green* man: [illegible] of [illegible]

[1] "Light from the East on the Colour Question," by W. [illegible] of *Nineteenth Century* for February, 1885.
[2] "The Colour Sense," by the Right Honourable W. E. G[illegible] of *Nineteenth Century* for October, 1877.

ılied (sometimes apparently by contrast with the racteristic colour). Thus all wines which are not of ıe red tint are loosely styled *white wines*, though ir real colours are various shades of yellow, golden, l orange. Again, light-coloured hats, usually light y, drab, or brown, are often styled *white* hats, probably contrast with the black chimney-pot hat so common in gland. The colour-term *green* with the figurative ıse of "fresh," is applied to unseasoned timber and to shly-quarried stone.

*Metals.*—Whilst some few metals have a sufficiently iking colour to give rise to a special colour-name—*e.g.*, *ppery*, *bronze*, *brazen*, *golden*, *aureine*, *steel-blue*, *leaden*, *n-grey*, *argent*, *silvery*, the most of them have a general nilarity of tint, and are loosely called *white* (probably contrast to the coloured metals), whilst a mere tinge of ıe in some of them leads to their being called *blue* (*e.g.*, ıd, zinc, steel).

Curious applications occur in trade names: thus, *white etal* is used of any cheap alloy resembling silver in ıpearance; *white brass* is a whitish alloy of copper and ıc; *gray iron* and *white iron* are cast iron whose fracre is grey or white; whilst *white lead*, *zinc white*, *white senic* are the white oxides of the metals in question; *d lead* is the red oxide of lead, and *black lead* is really umbago (which resembles lead only in its property of arking paper); *white*, *yellow*, *orange*, and *red*, when pplied to gold, denote alloys of gold in which the golden olour is modified *slightly* in the directions indicated; *ed-short* is an epithet descriptive of malleable metals hich are brittle when hot.

*Blue and Black.*—There is a curious confusion between *ark blue* and *black* in both English and Hindústání. hus, in English there are *blue-black*, *invisible blue* (both sed of a very deep blue almost black), *black and blue* applied to a bruise), *black as ink* and *inky black* (although ıost inks are nowadays blueish) often applied to rainlouds (nimbus) and to the deep indigo blue of the deep ea, quite like the Hindústání phrase *kálá pání* (*lit.* black vater) used of the sea. Dark blue cloth is by some (even y ladies) habitually called *black;* the writer has also nown *black*berries miscalled *blae*berries (by a Scotchvoman), although *blae* is literally blue; this is quite like he Hindústání word *kálá*, which is used for both *black* and *lark blue*, especially in cloth. This confusion is curious n English, wherein the terms *jet-black*, *jetty*, *coal-black*, exist for a true black. In the melody, "The Coal-black Rose," the colour is attributed really to a person of the ıame of Rose.

*Physical States.*—Colour-terms are applied to physical states, sometimes in an exaggerated sense (the name of a bright colour being ascribed to any faint tint of the same), and sometimes in a special and almost inexplicable sense.

Thus we speak of *the black death*, *as black as death*, *black looks*, *looking as black as thunder*, *scarlet fever*, *yellow fever*, *jaundice*, *turning green with sickness*, *being beaten black and blue*, *blue with cold*, *a fit of blue devils*, *pale* or *white with illness* or *with loss of blood.*

*Mental, &c., States.*—The connection of colour terms with mental and moral emotions, conditions, and actions, is curious and often inexplicable.

Thus *black* is associated with the idea of evil—*e.g.* the *blackest of lies*, *black as sin*, *blackened with crime*, *as black as the devil;* and also with degradation in both English and Hindústání—*e.g.* to *blacken one's face* (Hind. *munh kálá karná*) implies disgrace in both languages. Again *black*, *purple*, *crimson*, *red*, *scarlet*, *pink*, *livid*, *pallid*, and *white* are all ascribed to rage; whilst *crimson*, *red*, and *scarlet* are also ascribed to shame, in both cases doubtless from their effect on the hue of the cheek. Further *crimson*, *red*, and *scarlet* are associated with crime (probably from their connection with blood), and also with sin generally—*e.g.* *red-handed*, *sins as scarlet*, the *scarlet woman*, &c. Next *black*, *yellow*, and *blue* are all used of depression of spirits—*e.g.* in the words *melancholy*, *atrabilious*, *jaundiced*, a *fit of the blues.* Again, *green* and *verdant* are used of the freshness of youth and of the state of a novice, and in this use both these colour-terms are oddly attributed to the eye; whilst *green* is also applied to (unusual) freshness in old age. The terms *green*, *blue* (*e.g.* a blue funk), *pale*, *pallid*, *livid*, *ashy*, *gray*, and *white* are all used as descriptive of fear; similarly the words χλωρος (commonly translated *green*) in Homer and *zard* (commonly translated *yellow*) in Hindústání are used of fear.

Again, *blue* is sometimes associated with religious feeling, and also with literary or scientific pursuits among women, *e.g.*, *blue-stocking*. Lastly, *white* is associated with the idea of good (perhaps in contrast to black, which goes with evil), *e.g.* *white lie* (*i.e.* a slight or venial lie), to be *whitewashed* (*i.e.* freed from debt), and extreme *whiteness* is associated with purity (probably from the pure whiteness of snow) *e.g.* *sins shall be as white as snow*, *white-robed angels*, &c.

*Summary.*—With such a looseness in the use of colour-terms in modern English and Hindústání as exemplified above, it seems (to the writer) that it is hardly possible to draw inferences as to the strength of the colour-sense in either the past or present from the (supposed) correct or incorrect application of colour-terms by other nations. Paucity of colour-terms is probably fair evidence of a poor colour-sense, whilst an abundance of the same is probably good evidence of a fine colour-sense. Viewed by this test, the colour-sense evidenced in the Homeric poems is certainly poor, and that of the natives of India is also poor compared with that of modern western nations; as to the latter, it may be said that a great development of colour-sense is now going on, and much more rapidly than in the past, judging from the frequent additions to the stock of dyes and pigments of late years, especially since the discovery of aniline and its derivatives.

*Natives of India.*—The author of "Light from the East on the Colour Question" considers that there is a "highly-developed colour-sense among the natives of India," and adduces the Indian coloured textile fabrics and works of art as evidence of this. This does not agree with the present writer's experience from a residence extending over twenty-three years in North India. The textile fabrics have certainly a good blending of colours; the cloth dyes and colours laid on pottery and other art-productions are also often beautiful. But the cloth-workers, dyers, potters, and other artisans in colours, and the educated classes, are the few among whom the colour-sense is well developed, and they are few among the 250,000,000 of India. The colour-terminology of Hindústání is poor, especially out of the classes above-named. Moreover, in the writer's experience the eyesight of the uneducated masses in India is defective in every way. They have great difficulty in threading a needle, in reading small type or small MS., also in reading at all except in a strong light, in discriminating colours, and (strangest of all) in making anything out of a picture, engraving, or photograph. This last defect is at first sight most surprising to an Englishman: it would seem as if a certain "picture-education" were necessary to develop a "picture-sense." A villager in India, or a quite uneducated servant, will sometimes examine a picture sideways, or even upside down, and will hazard the most incongruous ideas as to the subject, even when it is that of an object quite familiar to him.

ALLAN CUNNINGHAM

## *ENSILAGE*

WE have observed with satisfaction, if we may be allowed to say so, the increasing attention which is being devoted to the subject of ensilage in this country, not only in view of the importance of this method of storing fodder as an auxiliary to the farmer, but because it evokes discussions which tend to the diffusion of the teachings of biologic science, and to widen the search after natural knowledge. The harvesting of ripe crops has become stereotyped by custom reaching back into the dim past; the practice of ensilage, on the other hand, involves a view of plant life which is not only foreign to our agricultural traditions, but is based upon less obvious teachings of nature, and it therefore demands a more intelligent cooperation of human industry. Notwithstanding these features, which make it a serious innovation, the unprejudiced acceptance of the system and the impartial spirit in which it is being practically investigated, testify to the growth of scientific culture amongst our agriculturists and to the general interest taken by them in the more recondite discussions of natural science which cannot fail to be widened by the study of the profound problems presented by the subject of ensilage. In contributing to the study of these we shall do so rather as observer than investigator, and as the text of our discussion we shall take Mr. Fry's excellent little work on "Sweet Ensilage." Whatever the fate of the theory of the silo expounded by the author—and it is certainly a bold excursion into the *terra incognita*—he furnishes us with a good and clearly expressed working hypothesis for the regulation of the system to the production of "sweet" ensilage, to which his efforts as an agriculturist have converged, he has sought a warrant in the teachings of vegetable physiology, and the theoretical account of the silo which has resulted may be stated in broad outlines as follows:—The crop to be ensiled is cut in the full vigour of the growth of the plant; the tissues of the plant do not die, but continue to exercise their organic functions for some time after being deposited in the silo. The rise of temperature which ensues in the silo is due to what the author terms "intercellular oxidation," or, from what we gather from the context, to the oxygen respiration of the cells.

In consequence of this increased temperature and its maintenance for a sufficient time, the cells of the plant are deprived of organic activity. The life of the plant under the restricting conditions of ensilation, induces an "intercellular fermentation," which manifests itself in one direction by the trans-generation of sugar into alcohol, the sugar being derived from the starch of the plant by hydrolysis. In regard to this function the author goes so far as to say: "When these transgenerations in the silo have been performed, the functions of the vegetable cells are at an end and they become inert and moribund." The formation of acetic acid in the silo, as also of lactic and other acids, are referred to ferment actions. The parasitic organisms present in the original mass are reduced to inertness by exposure to the elevated temperature produced in the silo, provided this is sufficiently high; nor can they resume their functions when the temperature falls to within the limits favourable to life. The ensiled matter, therefore, having attained and maintained for a sufficient time this suicidal temperature, is thenceforward without the pale of organic change. If, however, from any cause—the author gives prominence to two: viz. insufficient robustness of the cells and too large a proportion of water, which conditions, *e.g.*, are correlated in an immature growth—this critical temperature (at or about 50° C.) should not be reached, then the contents of the silo will, on cooling, become the prey of the bacterial life which has survived, and is ready to avail itself of favourable conditions for active development. The latter conditions determine the production of "sour" silage, the former of "sweet." In the chapter on the chemi[illegible] position of silage, in which analyses of vario[illegible] are given, special attention is directed to t[illegible] high proportion of albuminoid to amide nitr[illegible] which may be ranged in the latter class, [illegible] [illegible]eir superior feeding value.

As a necessary preliminary to our discussion of the phenomena of the silo, in which we shall follow the lines thus laid down by Mr. Fry, we will review a few of the more prominent features of the chemistry of plant life, which no writer on this subject can afford to leave out of consideration.

That they have been considered, to some extent, in the account of the silo above detailed, is evidently due to Mr. Fry's position as an agriculturist writing for agriculturists. The practical purpose of his investigation and description of ensilage was only attainable by aiming at *a* probable truth to the exclusion of the whole truth. Our attempt will be to do justice to such an aim and its results, at the same time to aid in maintaining the scientific perspective of the question.

Many fruitless definitions of the supposed ultimate distinctions between a plant and an animal have from time to time been advanced; and while the controversies to which they have given rise have but little interest to those who take the broader view of classification, still there are certain very marked distinctions between the vegetable and animal worlds, considered each as a whole, which are independent of all views as to their abstract import and of all attempts to reduce them to a typical expression. First, in regard to synthetical activity and the power of appropriating carbon and nitrogen—the characteristic elements of living matter—the position of the vegetable world is anterior to that of the animal: or, to attempt a definition, the synthetical work of plants is ultimate, that of animals proximate. Secondly, nitrogenous or proteid substances are not essential constituents of the more prominent structures, *i.e.* the fibrous skeleton of a living plant, whereas the tissues of the animal are largely composed of such compounds. With regard to the functions of the protoplasm of the vegetable as compared with those of the animal organism, we may quote Michael Foster ("Physiology," 2nd ed., 343):—"It is not unreasonable to suppose that the animal is as constructive as the vegetable protoplasm, the difference between the two being that the former, unlike the latter, is as destructive as it is constructive." Thirdly, the synthetic activity of plants does not cease with the cessation of life, but persists in some measure in the substances which it has built up. We use the term "synthetic" here in a wider sense. The vast aggregations of the vegetable life of past ages with which we are so familiar in so many forms sufficiently illustrate our meaning; and the study of the everyday work of the redistributing agencies of Nature upon moribund vegetable matter, will prove the same refractory relationship—the possession of a power of resisting change under their influence not possessed by animal matter. Resolution takes place to a certain extent, in degree depending upon the circumstances of its deposition, and the surrounding physical conditions, but there is always to be observed the tendency to *accumulate* the characteristic element carbon, at the expense of the oxygen and hydrogen; we have every reason to regard the processes by which this result is attained as a self-contained re-arrangement of the matter and energy, localised in and by the plant during its life, and as the result, therefore, of the same activity. The life-history of a perennial plant also points to a high end[illegible] the molecules which are built up into its p[illegible] for these are not, as in the animal, s[illegible] removal and renewal, but fixed and [illegible] At the same time they run a lon[illegible] to th[illegible]ging condition [illegible] which the nec[illegible] aboriginally [illegible] [illegible]itions of su[illegible] [illegible] of liquifica[illegible] [illegible] matter, the [illegible] of intrins[illegible] and the tendency to retain this energy in the form of derived compounds in which the carbon is proportionately accumulated.

Let us consider this endowment of energy of plants from a point of view more nearly that of the subject of these remarks—viz. the formation of the seed in an annual. We take it that every cell is impressed with the striving, so to speak, to bring about this result. In regard to the energy necessary, again we may conceive a storing up in the earlier processes of elaboration, together with a continuous supply from the external world. Supposing, now, the organic existence of the plant arrested by cutting during the period of inflorescence; the one supply is cut off, but what becomes of the other, the intrinsic energy and tendency of the organised matter in this direction? Analogy leads us to conclude that it flows on, expending itself on an unattainable end, until it fails from failure of the co-operative supply.

Now if this account of the relationship of the matter and energy of plants is generally true, we think they demand first consideration at the hands of investigators of ensilage. Mr. Fry attributes the rise of temperature in the silo to "intercellular oxidation." We think the term a good one, as it points to intrinsic oxygen exchanges. But we gather from the context that the oxydation referred to is at the expense of atmospheric oxygen. We think this qualification weakens the value of the term in diverting attention to a cause inadequate to produce the result. How much oxygen is contained or is supplied to the silo? Supposing it completely burned to carbonic anhydride and all the resulting heat effective in raising 100 times its weight of water 30° C. in temperature, is this sufficient on the most favourable calculation to raise the whole mass to 60°–70° C., the temperature which usually obtains? Why does the temperature continue to rise for some weeks after the crop has been ensiled, when from all causes the supply of oxygen must continually diminish? Apart from these considerations the conditions of the matter in the pit are surely unfavourable to oxidation by atmospheric oxygen, chiefly in the impediments to gaseous circulation and the absence of light. As we wish to confine ourselves to suggestions and to avoid statements of opinion, we do not hazard any conclusions on this point, but we ask for a comparison of the considerations drawn from the study of the intrinsic energy of plants with those from their relationships to the external world, in regard to this first phenomenon of the silo.

In regard to Mr. Fry's theory of "intercellular fermentation," we again think the term conveys a wider truth than his exposition. As an agriculturist he recognises two main kinds of ensilage products—sweet and sour—and we have already alluded to his account of their production.

Now, on what does this terminology turn, in as far as it is correlated with the chemical composition of the silage? Upon quantities of certain constituents which are a small fraction of the whole. It is, on the other hand, an axiom with the chemist, in his study of reactions, not to be led away by issues which are obviously subordinate. From a number of considerations which follow directly from the previous discussion, the cellulose fabric of the plant studied comparatively with the changes which it undergoes in the silo, is best calculated to throw light on the general nature and tendency of these changes. These changes involve a commerce of molecules, if we may use the expression, of which the appearance of small quantities more or less of particular acids or other compounds are minor results. We prefer the term "intercellular *commerce*" as less specialised than "fermentation"; and and in so far as the problems involved are essentially [illegible]cal, we think a study of the matter changes from [illegible] of view in the order pointed out by relative [illegible]d permanence of relationship to the plant structure, is better calculated to elucidate the nature of these transformations.

In regard to sour ensilage, and the view of it as resulting from bacterial fermentation, we have little to say. The study of the life of such organisms under the very peculiar circumstances of the silo has been thus far very slender. From the later researches of Nägeli and others, which have considerably modified the theory of anærobic fermentation as propounded by Pasteur, we are inclined to attach less weight to this probable factor of the changes in the silo than Mr. Fry.

Generally speaking, and as he admits, the whole subject needs a very exhaustive investigation, and as we would point out, on the widest basis, and altogether independently of its special bearings upon agriculture The scientific method must be followed, even though in particular experiments the silage were rendered unfit for food. The factors of the result must be caused to vary artificially that their influence may be severally measured. The silo may be heated in any suitable way, the organic matter may be sterilised as regards parasitic germs, substances may be added to modify the reactions, and many other and similar self-suggestive means employed to test particular issues. In conclusion we revert to our original text, and we congratulate Mr. Fry on having laboured well in a good cause. As an agriculturist he has exceeded in his investigations what was to be expected; but in his endeavour to give a scientific account of the silo simultaneously with the agricultural, we think he has disposed of the complications of the subject by repressing their consideration. It is to the somewhat thankless task of reproducing certain of these that we have addressed ourselves, with the view, as already stated, of aiding to keep the subject in its true perspective.

## *NOTES*

THOMAS DAVIDSON, LL.D., F.R.S., of Muirhouse, Midlothian, died, from an attack of lung disease, at West Brighton, on the 16th inst., in his sixty-ninth year. Dr. Davidson, who was so well known in the scientific world, more especially for his work on the "Fossil Brachiopoda," was a Fellow of the Royal, the Geological, and many other learned Societies, foreign as well as British. In 1851 he began his description of the "British Fossil Brachiopoda," which has been published from year to year by the Palæontological Society, the concluding supplements having appeared in the last volume of that Society in December 1884. Numerous memoirs on similar subjects have been published in the *Transactions* of several scientific Societies. Recently Dr. Davidson prepared a "Report on the Brachiopoda dredged by H.M.S. *Challenger* during the Years 1873–76." At the time of his death he was engaged upon a further monograph on recent Brachiopoda, the first part of which is now appearing in the *Transactions* of the Linnean Society. Dr. Davidson latterly resided at Brighton, and notwithstanding his other scientific avocations he devoted a considerable portion of his time to the perfecting of the town museum.

PRESIDENT CLEVELAND'S invitation to Prof. Agassiz to assume the direction of the United States Coast Survey has been hailed in America as an assurance that the new administration will encourage scientific work, and is not indifferent to survey, but is desirous of placing it under a head whose name and character would be a guarantee of success. The health of the Professor precluded his acceptance of the post; but beyond this he is of opinion that the guidance of the Coast Survey requires an expert. The problems to be decided, the methods to be employed, the men to be engaged, should, he thinks, be determined by one who knows the business. Any other person would be in danger of failure. In concluding an article on the subject *Science* says:—"The correspondence of Secretary Man-ning and Prof. Agassiz is to us an assurance that science will not be retarded, and that scientific men will not be slighted by any act of President Cleveland."

*Science* comments in a recent issue on an extraordinary statement published in certain New York and Boston journals to the effect that a committee which had been appointed to investigate the geological survey of the United States had found that illegal practices prevailed in the work of that department. It appears that no such committee ever sat; the whole was pure fiction. There was no report, no illegal proceedings, no examination. The officer to whom it was said the committee made this report has no authority to appoint or superintend such a committee, and the whole story had its origin in the fertile brain of an imaginative newspaper correspondent. It is well that this should be understood in this country, in case the baseless statements referred to should have made their way here.

THE Annual Meeting of the London Mathematical Society will be held on Thursday evening, November 12, and will be made special for the purpose of considering alterations in the rules, which will be proposed by the Council. At the same meeting it will be proposed to elect Mr. C. Leudesdorf and Capt. P. A. Macmahon, R. A., as new members of the Council in the place of Dr. Hirst, F.R.S., and Mr. R. F. Scott, who retire.

THE following are the conclusions of the Scientific Commission appointed by the Spanish Government to examine Dr. Ferran's method of treating cholera patients. They are abbreviated by the special correspondent of the *Times* in the cholera districts of Spain, writing from Valencia on October 12: (1) Dr. Ferran's inoculations cannot be considered inoffensive. (2) The attenuation of the comma bacillus has not been demonstrated. (3) The prophylactic measures conceived by Dr. Ferran are empiric, for they are in no wise governed by scientific rules or laws. (4) By means of the vaccination the epidemic is propagated. (5) It is not demonstrated by the results ascertained that the inoculations secure immunity from cholera. (6) The individual during the first days following his inoculation is rendered more susceptible to contract any other form of disease. (7) This is due to the fact that the inoculation disturbs more or less profoundly the physiological equilibrium which it is so necessary to maintain during a period of epidemics. (8) The results as seen by the Commission do not prove immunity from cholera. Neither is it possible to obtain conclusions from statistics relating to inoculations, because general laws cannot be deduced from isolated facts.

DR. QUAIN delivered the Harveian oration on Monday afternoon before the Royal College of Physicians. He set himself to answer two questions: first, why it is that among a vast number of persons, alike in ancient and in modern times, medicine has not enjoyed that high estimate of its value, as an art and as a science, to which it is justly entitled; and, secondly, whether we have any grounds for anticipating a more satisfactory future for medicine, either in the security of the foundations on which it is laid, or in the consequent appreciation of it by the public. In the course of the oration Dr. Quain spoke of the progress of medical science before the foundation of the College of Physicians; the advances made in our knowledge of etiology, especially in the practice of arresting the diffusion of disease by limiting the spread of contagion, and of improvements in our knowledge of pathology. Having pointed out the progress which science and art have made in every direction, Dr. Quain produced statistical evidence that the improvement has been productive of substantial results. In answer to the second question he quoted the words of "one of the most eminent of our statesmen," to the effect that in a generation or two the medical profession would be far in advance of the other learned professions."

WE lately quoted in NATURE, with a comment on the exceedingly unusual character of such an announcement from America, a statement to the effect that the Astronomical Observatory of Beloit College was being closed on account of want of funds. We are very pleased to learn from *Science* that this statement is quite erroneous. On the contrary, Prof. Bacon, the Director of the Observatory, states that new arrangements have been made for carrying on additional observations in meteorology, and that especial attention will be paid to solar and spectroscopic work with greater facilities than before. This, we may observe, is happily by no means a surprising or novel announcement from across the Atlantic.

THE new School of Metallurgy which has recently been added to the Birmingham and Midland Institute, was formally opened on September 24, when Prof. Chandler Roberts, F.R.S., delivered a lecture on the Development of Technical Instruction in Metallurgy. Prof. Roberts pointed out how very recent has been the introduction into this country of systematic instruction in metallurgy. After referring to the important share which Dr. Percy has had in the development of metallurgical work in England, and to the steps taken by the Committee of Council on Education for its practical working, Prof. Roberts insisted on the importance of combining theory and practice, and referred at length to the methods adopted in the School of Mines. A full report of Prof. Roberts' lecture will be found in the *Chemical News* of October 9.

THE increasing efficiency with which electric lighting can be applied has recently been shown by Messrs. Woodhouse and Rawson, who, at a *soirée* at Guy's Hospital, lit up the building with their incandescent lamps, worked off Faure Sellon accumulators, which were only delivered on the morning of the *soirée*. Equally efficient was the lighting supplied by the same firm at the Leicester Exhibition of the Sanitary Institute of Great Britain. It is certainly a great convenience that such temporary illuminations can be effected under almost any conditions.

IN an article on the use of the French Academy, *Science* says:—"But, aside from all personal considerations, there remains a question whether an organisation like the French Academy may not perform an important service to the country by giving its collective authority to the encouragement of excellence in the use of language. May not its criticism of its own members, its judgment of works presented to it, its bestowal of academic honours, its election of associates, its public discourses, and its serious scrutiny of the vocabulary and phraseology of the language in their combined influence, be a very powerful agency in the promotion of literary excellence? May it not become a sort of schoolmaster to the nation, incapable of making good writers out of bad, but helpful in discipline? Who can tell what has been the net gain to France from such a society? Is the clearness, the precision, the symmetry, the finish of a good French style worth having? What would the German language be to the world if there had been a German academy at work for 250 years smoothing its roughness and insisting upon clear, unencumbered, and pleasing forms of expression?"

THE Calendar of the University College of North Wales, at Bangor, has just been published. Besides the usual information, examination papers and lists, it contains a brief sketch of the establishment of this college, which now enters its second year, and which promises to have a success worthy of the efforts by which it was founded. The thirst of the Welsh people for knowledge and for the education of their children is well known, and the introduction to the "Calendar" states that never before in so short a period have so many persons, either in England or in Wales, subscribed towards a movement for the promotion of higher education. In twelve months the list rose to upwards of 30,000*l*., and by the end of 1884 it had exceeded 37,000*l*.

WE have received Prof. Rockwood's account of the progress in vulcanology and seismology in the years 1883, 1884, from the Smithsonian Report for 1884. Under Vulcanology he treats of the volcanic eruptions during the two years (dealing mainly with the Krakatoa eruption), and of the investigations of former volcanic activity. In seismology he divides his subject into earthquake lists of 1882 and 1883, special earthquakes of 1883 and 1884, lists of former earthquakes, and theories of earthquakes. In seismometry Prof. Rockwood deals with instruments and their records. The pamphlet, which should be a *vade mecum* for all engaged in investigating seismic phenomena, concludes with a bibliographical list of all the books and papers relating to the subject, which appeared during the two years under review. This list is surprising for its length and variety.

VUIBERT'S *Journal de Mathématiques Élémentaires*, which has had an existence of nine years in a lithographed form, commences its tenth year in print. It may be called the French schoolboys' mathematical journal, for it is addressed specially to them, and all the solutions are contributed by them. It appears fortnightly from October 1 to July 15, and the terms of subscription are very moderate. We have unfortunately in this country nothing to correspond to it, and it may therefore be useful to signalise its existence to mathematical masters.

AT a meeting of the Council of the National Fish Culture Association held on Friday last under the presidency of the Marquess of Exeter, it was resolved to take immediate steps to conduct a series of investigations and observations on the ocean in regard to its temperature at various depths; also as to the habits of fish, their spawning grounds, their enemies, and the cause of their erratic migrations. The Duke of Edinburgh, it was stated, had much interested himself in the subject, and had obtained the cooperation of the Admiralty and Trinity Board in aiding the Association to carry out the observations with the view of promoting marine fish culture and undertaking it on a thoroughly scientific basis.

THE Severn Fishery Board have made arrangements with the National Fish Culture Association to incubate salmon ova. When hatched out the fry will be placed in the waters under the control of the Board, which is doing its utmost to cultivate all species of Salmonidæ. The National Fish Culture Association will, it is understood, render similar service gratuitously to other Boards, in order to assist in developing the inland fisheries of the United Kingdom.

THE Institute of Chemistry has obtained a Royal Charter of Incorporation from the Privy Council, and it is intended to celebrate the occasion by a dinner on November 6.

THE following Penny Science Lectures will be given at the Royal Victoria Hall and Coffee Tavern, Waterloo Bridge Road, during the ensuing weeks.—On Tuesday, October 27, Mr. W. D. Halliburton will lecture on the "Circulation of the Blood"; on Tuesday, November 3, Sir John Lubbock will lecture on "Ants"; on Tuesday, November 10, Mr. W. Lant Carpenter will lecture on "Electrical Fire Alarms in America."

A SHOCK of earthquake was felt at half-past seven o'clock on the morning of the 13th in Granada and the surrounding country. The movement is described as a long trepidation, with a rumbling noise. At Palermo a shock occurred on the morning of the 15th. A house, three storeys high, fell in, and a number of persons were buried in the *débris*.

IN connection with the General Italian Exhibition held in Turin last year, the Italian Meteorological Society has just issued an interesting *brochure* on the present state of astronomical, physical, and meteorological studies in the peninsula. In these departments the show was thoroughly national, special prominence having been given to those branches which are at present most widely cultivated in Italy. Thus in terrestrial physics full scope was given to seismology, vulcanology, and geodynamics, all which studies, owing to the special local conditions, have here been associated with some of the most illustrious names in science. Meteorology was well represented by specimens of the best apparatus from the chief meteorological stations in the country, and in astronomy the progress of all the local observatories was fully illustrated. Amongst the objects on view were astronomical, physical, and meteorological apparatus; charts, maps, designs, photographs; printed and manuscript works on these subjects. Although still far behind some other countries in the production of scientific instruments, the display showed that in recent times Italy has made considerable progress in this branch of mechanics. To illustrate the history of these sciences the exhibition included some curious old instruments associated with the names of illustrious pioneers, who laboriously prepared the way now followed by their more fortunate successors living in better times and enjoying the advantage of more perfect appliances. The pamphlet contains a complete list of the ninety-one meteorological and geodynamic stations already established throughout the peninsula, as well as the names of exhibitors, to whom diplomas, gold and silver medals, and other distinctions were awarded.

MR. MELLARD READE'S presidential address to the Liverpool Geological Society was on "The North Atlantic as a Geological Basin." After discussing the form and nature of the ocean-bed so far as is disclosed by the latest soundings and dredgings, he pointed out that all along the coast of Spain and North Africa the bottom was exceedingly irregular, as proved by the soundings for the telegraph cables, consisting apparently of mountains and valleys. On the opposite coast of South America, and especially about the mouths of the Amazons, the soundings were comparatively shallow and of nearly uniform depth. Taken together with the known great depth of alluvial deposits at the mouths of all the great rivers where borings had been made, and the undoubted great age of the Amazons Basin, Mr. Reade arrives at the opinion that this plateau is a submarine extension of the delta proper, consisting of geologically modern sediment probably thousands of feet thick. The same reasoning, he points out, will apply to other great rivers and coasts where similar conditions exist.

FROM a series of experiments by Herr Graber, relating to the effects of odorous matters on invertebrate animals, it appears probable that in the case of many insects neither the antennæ nor the palpi can be absolutely pronounced the most sensitive organ of smell, inasmuch as the one organ is most sensitive for some odorous matters, and the other for others.

THE additions to the Zoological Society's Gardens during the past week include a Purple-faced Monkey (*Semnopithecus leucoprymnus* ♀) from Ceylon, presented by Major Norris; a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Mr. J. H. Fielding; a Common Marmoset (*Hapale jacchus*), a Black-eared Marmoset (*Hapale penicillata*) from Brazil, presented by Miss Knowles; a Common Marmoset (*Hapale jacchus*) from Brazil, presented by Lady Cowley; a Common Hare (*Lepus europæus*), British, presented by Mr. F. J. Allpress; a Mexican Souslik (*Spermophilus mexicanus* ♂) from Mexico, presented by Dr. Stuart; a Herring Gull (*Larus argentatus*), British, presented by Mr. J. G. Taylor; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, a Green Monkey (*Cercopithecus callitrichus* ♀) from West Africa, deposited; an Ariel Toucan (*Ramphastos ariel*) from Brazil, purchased; a Hoolock Gibbon (*Hylobates hoolock* ♀), received in exchange.

## *OUR ASTRONOMICAL COLUMN*

THE VARIABLE-STAR V CYGNI.—In Dr. Hartwig's ephemeris of the variable stars for the present year a maximum of V Cygni is doubtfully assigned to November 15. The change in the brightness of this strikingly red star was notified by the late Mr. Birmingham in May, 1881. The several determinations of the time of maximum in the following year were very discordant; thus, Dr. Lindemann (who made an interesting communication on this star to the St. Petersburg Academy in January 1884) fixed it on August 31 "auf wenige Tage sicher"; Schmidt gave July 17, while Prof. Safarik considered it was reached on June 17. This divergence induced Dr. Lindemann to commence regular observations of the star in August 1882, details of which will be found in his paper (*Bulletin de l'Academie Imperial des Sciences de St. Pétersburg*, t. xxix.). The variation appeared to be from 6·8 m. to below 10 m., and the period indicated by the observations of 1882 and 1883 was about a year, though a longer one is now assigned. Several of Dr. Lindemann's notes are worthy of attention. On July 19, 1881, the star had a nebulous cometary aspect, with sensible diameter. On August 13 in the following year it was more stellar, and had no longer the nebulous appearance it presented in 1881, though a month later this was again suspected. On May 13, 1883, we read: "V funkelt sehr stark, leuchtet momentan auf und verschwindet dazwischen beinahe," though a comparison star DM + 47°, 3162 showed a steady light. On July 27 it shone as steadily as the neighbouring stars, without any nebulous appearance. On October 8—"sehr verschwommen"; a week afterwards, this aspect was not remarked, though the images of surrounding stars were very indifferent. At the end of the same month V was again stellar. Variations in the intensity of the colour were also remarked.

The place of this star for 1885·0, according to meridian observation at Pulkowa is in R.A. 20h. 37m. 35·7s. Decl. + 47° 43′ 53″.

OCCULTATION OF ALDEBARAN ON NOVEMBER 22.—The Greenwich mean times of disappearance and reappearance of this star and the corresponding angles from north point, in the occultation on the evening of November 22, may be pretty closely determined for any place in this country from the following formulæ:—

$$\text{Time of disap.} = \overset{\text{h.}}{9}\ \overset{\text{m.}}{45\cdot7} + [0\cdot2259]\,L + [9\cdot3110]\,M$$
$$\text{,, reap.} = 10\ 56\cdot2 + [9\cdot8575]\,L + [9\cdot4779]\,M$$

$$\text{Angle at disap.} = 104\overset{\circ}{\cdot}1 + [0\cdot358]\,L - [9\cdot307]\,M$$
$$\text{,, reap.} = 281\cdot6 - [0\cdot412]\,L + [9\cdot246]\,M$$

In which the latitude of the place is put = 50° + L, and M is the longitude in minutes of time counted positive towards the east. The quantities within brackets are logarithms.

The above equations are founded upon the following results of direct calculation:—

| | Disappearance | | Reappearance | | Angles from N. Point | |
|---|---|---|---|---|---|---|
| | h. m. s. | | h. m. s. | | ° | ° |
| Greenwich ... | 9 48 9 | ... | 10 57 15 | ... | 108 | 278 |
| Edinburgh ... | 9 53 5 | ... | 10 56 39 | ... | 120 | 264 |
| Dublin ... ... | 9 46 10 | ... | 10 51 0 | ... | 117 | 265 |

DOUBLE-STARS.—Two important series of measures of double-stars have lately appeared in the *Astronomische Nachrichten*: the first in Nos. 2677-78, by Dr. R. Engelmann, of Leipsic, in continuation of a series previously published; the second by M. Perrotin, made at the Observatory of Nice, in Nos. 2684-85. According to the Leipsic observations of Σ 2173, for which Prof. Duner found a period of 45 years only, calculation is not yet so much in error, as for a first approximation, and so difficult a star, might well have been anticipated. Dr. Engelmann's mean result is, for 1883·88, position, 24°·8; distance, 0″·23; the orbit gives 34° and 0″·2. The Leipsic series contains measures of many of Mr. Otto Struve's and Mr. Burnham's stars.

## *ASTROPHYSICAL NOTES*

STARS WITH SPECTRA OF THE THIRD TYPE.—[illegible] has published an important catalogue of stars [illegible] spectra. Following Prof. Vogel's classification he prefers to regard the spectra with bands fading away towards the violet as a subdivision of the same type as those in which the bands fade away towards the red, rather than, with Secchi, to make them into a separate class. Dunér's type III. *a*, therefore, corresponds to Secchi's third type and his III. *b* to Secchi's fourth type. Prof. Dunér's purpose in forming this catalogue is to supply the means for future observers to detect change in these spectra should any such occur, for, as he points out, these stars are probably in a very advanced state of development, and we may therefore, perhaps, hope to discover some day changes in their spectra which, carefully studied, may lead to important results as to the nature of suns. They are the more interesting, also, because variable stars of long period usually belong to this class.

With this view Prof. Dunér has carefully examined all the known objects of this type which are visible in his latitude, and for which the optical means at his command were sufficient, and he has catalogued 297 stars of type III. *a*, that is, with bands shading off towards the red, and 55 of type III. *b*, with bands shading off in the opposite direction. An important section follows giving a list of stars which different astronomers have regarded as belonging to the third class, but which Dunér cannot so classify. Only in a very few instances, however, is there any good reason to suspect a change in the spectrum. In the great majority Secchi, whose observations supply most of these cases of discrepancy, had himself at one time or another registered the star as being of the second type, *i.e.* without bands, or else had especially remarked on the extreme feebleness of the bands which he thought he saw. There are, however, three stars observed by D'Arrest for which the evidence of change seems stronger, viz. 24034 LL., D.M. + 60° 1461 and D.M. + 36° 2772. Prof. Dunér has also failed to find Schjellerup No. 249, which is, perhaps, a long period variable, and he draws special attention to R Andromedæ, a star the spectrum of which, though of type III. *a*, presents some very marked peculiarities. Great care has been taken in the determination of the positions of the bands in the different spectra. It is clear, as many spectroscopists have already observed, that the bands of type III. *a*, occupy the same positions in all the spectra of the type, and the same is true of the bands of type III. *b*. With regard to the former class, the sharp dark edges on the more refrangible sides of the bands generally coincide with strong metallic lines; thus one of the most prominent bands is terminated by the *b*-lines of magnesium. The nature of the connection between the bands and these metallic lines is not at all clear at present, the symmetrical arrangement of the bands seeming to suggest that they are due to some one substance rather than to several. The three principal bands of the spectra of the other type Prof. Dunér considers to be unmistakably those of a carbon compound, and to correspond to the bright bands so familiar in the spectra of comets. The determinations of the wave-lengths of the bands in spectra of this type are necessarily not quite so accurate as those of the bands in spectra of type III. *a*, but if Prof. Dunér's measures are accepted, this most important correspondence may be considered fully established. But, apart from the value of these measures, Prof. Dunér's catalogue, with the full and clear descriptions he has appended to every star, will be of the utmost service to future observers of these interesting and beautiful objects.

THE COMET OF 1866 AND THE METEORS OF NOVEMBER 14.—Prof. D. Kirkwood has recently pointed out in a paper read before the American Philosophical Society, that there is distinct evidence that there are three meteoric swarms travelling in the orbit of Tempel's comet. Of these the principal group is the one which produced the great showers of 1833 and [illegible] of which Prof. Adams showed to be about 33·25 years. [illegible] Prof. Kirkwood identified a second group [illegible] the [illegible] meteoric showers given by Humboldt and [illegible] of which would be about 33·31 years. [illegible] from this group will be due about Novemb[illegible] display [illegible] commence in Novem[illegible] the pre[illegible] the third cluster has been [illegible] period [illegible] and its next re[illegible] 1912 [illegible] suggests th[illegible] dimin[illegible] a comet [illegible] comet [illegible] appeari[illegible] and largest [illegible]

## *ASTRONOMICAL PHENOMENA FOR THE WEEK*, 1885, *OCTOBER* 25-31

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on October* 25

Sun rises, 6h. 44m.; souths, 11h. 44m. 7·5s.; sets, 16h. 45m.; decl. on meridian, 12° 16′ S.: Sidereal Time at Sunset, 19h. 2m.

Moon (two days after Full) rises, 17h. 32m.*; souths, 0h. 46m.; sets, 8h. 11m.; decl. on meridian, 12° 52′ N.

| Planet | Rises | | Souths | | Sets | | Decl. on meridian |
|---|---|---|---|---|---|---|---|
| | h. m. | | h. m. | | h. m. | | ° ′ |
| Mercury ... | 7 18 | ... | 12 7 | ... | 16 56 | ... | 14 22 S. |
| Venus ... | 10 56 | ... | 14 38 | ... | 18 20 | ... | 24 54 S. |
| Mars ... | 0 1 | ... | 7 26 | ... | 14 51 | ... | 15 30 N. |
| Jupiter ... | 3 15 | ... | 9 32 | ... | 15 49 | ... | 2 33 N. |
| Saturn ... | 20 13* | ... | 4 21 | ... | 12 29 | ... | 22 17 N. |

* Indicates that the rising is that of the preceding day.

*Occultations of Stars by the Moon*

| Oct. | Star | Mag. | Disap. | Reap. | Corresponding angles from vertex to right for inverted image |
|---|---|---|---|---|---|
| | | | h. m. | h. m. | ° ° |
| 25 ... | B.A.C. 987 ... | 6½ ... | 3 0 ... | 4 10 ... | 137 313 |
| 26 ... | B.A.C. 1256 ... | 6 ... | 22 3 | near approach | 151 — |
| 28 ... | B.A.C. 1930 ... | 6½ ... | 0 0 ... | 1 6 ... | 51 249 |
| 29 ... | 1 Cancri ... ... | 6 ... | 22 5 ... | 22 26 ... | 115 164 |

*Phenomena of Jupiter's Satellites*

| Oct. | | h. m. | | Oct. | | h. m. | |
|---|---|---|---|---|---|---|---|
| 25 | ... | 4 3 | II. occ. reap. | 29 | ... | 6 0 | IV. occ. disap. |
| 28 | ... | 6 32 | I. tr. ing. | 29 | ... | 6 10 | I. occ. reap. |
| 29 | ... | 3 7 | I. ecl. disap. | 30 | ... | 3 19 | I. tr. egr. |

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

| Oct. | | h. | | |
|---|---|---|---|---|
| 28 | ... | 17 | ... | Saturn in conjunction with and 4° 8′ north of the Moon. |

## *GEOGRAPHICAL NOTES*

A recent Blue-book (Siam, No. 1, 1885) contains a report by Mr. Archer, of the Consular service in Siam, on silk-culture in the province of Kabin, which lies on the eastern side of the Siamese delta, at the foot of the mountains separating the Meinam valley from that of the Meiking. In the course of his journey Mr. Archer came across certain Laos settlements, of which he gives an interesting account which is deserving of note, on account of the very little known of the Laos. He says the settlements in the provinces of Pachim and Nakon Nayok are, as it were, the south-western outposts of the Laos race, which forms the bulk of the population of Eastern and Northern Siam, but they are "phung khao," or "white-bellied," and therefore distinct from the "black-bellied," or inhabitants of the Chiengmai provinces. They are not, however, the original inhabitants of these provinces, but captives from Muang Kalassin, a province to the north east of Korat, formerly dependent on Wien Chan, who, after the war waged successfully by the Siamese against that ancient kingdom about sixty years ago, were transported to and allowed to settle in the country extending from the province of Nakon Nayok to that of Battambong. This country consists, for the most part, of a series of slight and gradual elevations and depressions, the dwellings, gardens, and any other plantations being generally situated on the former, whilst rice is cultivated [illegible] latter. The population is sparse, and consequently the [illegible] of the country is covered with jungle. The inhabit- [illegible]ingly indolent, and appear unable to exert them- [illegible] more than enough rice for their bare sustenance. [illegible]ving is of the simplest description, and their [illegible]m any commercial centre and outside any [illegible] foreign goods, with the exception of cotton, [illegible] them. All Laos tribes, however, are [illegible]dolence. Those living in the pro- [illegible] more active, and devote more [illegible] to the rearing of silkworms. [illegible] having a poorer soil at a [illegible]bitants to devote more [illegible] livelihood.

Mr. Coutts Trotter read a paper at the Aberdeen Meeting of the British Association "On Recent Explorations in New Guinea," bringing up to date the information he laid before the Section two years ago. It deals with certain hydrographical and other physico-geographical questions on which light has been lately thrown by Mr. Chalmers's journey, and by the ascent of the Amberno River, and points to the conclusions to be drawn from certain temples, with a special priesthood and objects of worship lately discovered—implying an order of religious ideas quite foreign to the Papuan mind. As regards the natives of New Guinea, he believes the conflicting jurisdiction, and different views as to the mode of dealing with them, must be prejudicial to their interests.

The Arctic steamer *Alert* returned to Halifax on October 18 from Hudson Bay with the observation party who have spent fifteen months there testing the practicability of that route for navigation from the Canadian north-west to Europe. The result of the observations shows that the average temperature is not so low as was expected, nor so low as the average winter temperature in the North-West. The lowest monthly average was 30° below zero. The ice observations show that the Hudson Straits and Bay are navigable by properly built and equipped vessels for from three to four months—from July to October. While this report is somewhat favourable, doubts are expressed in Canada whether the Hudson Bay route can ever be made practicable.

## *THE GREAT OCEAN BASINS*[1]

### II.

The advances during recent years in the knowledge of the forms of life inhabiting the floor of the ocean surpass those in any other department of oceanic investigation. Thousands of new organisms have been discovered in all seas and at all depths in the ocean, and either have been, or are now being, described by specialists in all quarters of the world. There does not seem to be any part of the ocean bed so deep, so dark, so still, or where the pressure is so great as to have effectually raised a barrier to the invasion of life in some of its many forms. Even in the greater depths all the great divisions of the animal kingdom are represented.

As might have been expected, forms of life are most rich and varied in the shallow water surrounding the continents, where there is abundance of food, sunlight, and warmth; where there is motion, rapid change of water through currents, and other congenial conditions. At the depth of half a mile there are still numerous animals, though many of them differ from those of shallower depths, but plant-life seems to have wholly disappeared, if we except the diatoms and calcareous algæ, whose frustules and skeletons have fallen to the bottom from the surface, carrying with them some of their protoplasm and chlorophyll.

At the depth of one mile there are a few animals which are barely distinguishable from, if they be not identical with, shallow water forms; but the majority of the animals are specifically distinct from those found within the 100-fathom line, and many of them belong to species peculiar to the deep sea, and are universally distributed over the ocean bed in deep water.

As we descend into still deeper water, and proceed further seawards from the borders of the continents, species and the number of individuals become fewer and fewer, though they often present archaic or embryonic characters, till a minimum is reached in the greatest depths furthest from continental land. Distance from continental land is, indeed, a much more important factor in the distribution of deep-sea animals than actual depth.

If we neglect the Protozoa and compare the results of twelve of the *Challenger's* trawlings and dredgings in the central line of the Pacific, in depths greater than 2000 fathoms, on globigerina ooze, radiolarian ooze, and red clay, with twelve trawlings and dredgings taken under similar conditions and depths, but on the blue and green muds within 200 miles of the continents, we find that the Central Pacific stations have yielded 92 specimens of animals belonging to 52 species, all, with two doubtful exceptions, new to science, and among them 13 new genera; on the other hand, the stations near the continents have given over 1000 specimens belonging to 211 species, of which 145 are new species and 66 belong to species previously known from

[1] Lecture delivered at the Aberdeen meeting of the British Association by Mr. John Murray, Director of the *Challenger* Reports. Continued from p. 584.

shallower water. These numbers are not final, but the proportions are not likely to be greatly altered when the whole of the *Challenger* Reports are completed. These facts may be in part explained by the greater abundance of food present in the continental *débris* which forms the chief constituent of the terrigenous deposits; but it is probably more closely connected with the greater distance of the seaward stations from the original place of migration. We must suppose that all deep-sea animals have been derived originally from shallow water; those which descended first into deeper water have, generally speaking, been able to migrate to a greater distance seawards than those which set out later, and being derived from older stocks they have retained in the great deeps some of the characters which are now regarded as archaic and embryonic.

Although no new types of structure have been discovered in organisms from the deep sea, the peculiar modifications which animals have undergone to accommodate themselves to abysmal conditions are sufficiently interesting and remarkable; the eyes of some fish and crustaceans have become atrophied or have disappeared altogether, while in others they have become of exceedingly large size or have been so modified as to be scarcely recognisable as eyes: for instance, in the case of the scopelid fish *Ipnops*; fins and antennæ have become extraordinarily elongated and at times appear to simulate the alcyonarians of the deep sea. The higher crustacea and some families of fish have very few and very large eggs in the deep-sea species, while their shallow-water representatives have a very large number of very small eggs, showing apparently that the deep-sea species have relatively few enemies. While some groups, for instance the Pycnogonids, Tubularians, and Nudibranchs, have much more gigantic representatives in the deep sea than in shallow water, the representatives of the majority of groups, and especially the Gasteropods and Lamellibranchs, are much smaller, and generally speaking have a dwarfed and delicate appearance, the shells being poorly supplied with carbonate of lime. Indeed the solid tissues of most deep-sea animals are but feebly developed when compared with shallow-water forms. The experienced dredger has, as a rule, little difficulty in recognising a deep-sea species in a dredging from its general appearance. Many deep-sea animals emit, and some have special organs for the emission of, phosphorescent light, which appears to play a large *rôle* in the economy of deep-sea life.

One of the most striking facts with respect to deep-sea animals is their very wide distribution—the same species being found in all the great ocean basins. At the depth of half a mile identical species are dredged off the coast of Scotland and off the coast of Australia at the Antipodes; the nearly uniform conditions, existing everywhere at depths greater than half a mile, facilitates the wide distribution of species which have once accommodated themselves to a life at that depth. The same consideration probably explains the occurrence of some identical and nearly identical species in the shallow waters of the temperate and polar regions of both hemispheres.

Among the higher crustacea the Brachyurans, which are regarded as a modern group, are found in great numbers in shallow waters, but have very few representatives in deep waters, and appear to be quite absent from the abysmal regions. On the other hand, the representatives of the Schizopoda, Anomoura, and Macrura, which are regarded as older groups, are widely distributed in the deep sea; many similar instances of this kind could be given. The stalked Crinoids, the Elpidiidæ among the Holothurians, the Pourtalesiæ and Phormosomas among the Echinids, and other groups, have now no representatives in depths less than 100 fathoms, but are widely distributed in all greater depths; while many genera are confined to the abysmal regions. We are not as yet, however, in a position to fully discuss many curious points in distribution, even did time permit.

It may be urged that after all the few hundred scrapings of our small trawls and dredges can give but a very inadequate idea of the condition of things over the millions of square miles covered by the ocean, but against this it may be argued [illegible] great force that as the same animals and deposits occurred [illegible] and again with little variation, we doubtless have eve[illegible] tolerably complete knowledge of deep-sea life.

When we turn to the surface waters, one may exclaim [illegible] dull and stupid soul that would not rejoice at the first a[illegible] ance with the teeming pelagic life of the ocean, rich in [illegible] forms and varied colours, or that would no[illegible] struck [illegible] at the magnificent displays of phosph[illegible] light forth on a dark night from the surface of an equatorial ocean, like flashes of "spirits from the vasty deep."

"Beyond the shadow of the ship
I watched the water snakes;
They moved in tracks of shining white,
And when they reared the elfish light
Fell off in hoary flakes.

"Within the shadow of the ship
I watched their rich attire;
Blue, glossy green, and velvet black,
They coiled and swam, and every track
Was a flash of golden fire.

"Oh, happy living things! No tongue
Their beauty might declare.
A spring of love gushed from my heart,
And I blessed them unaware."

Experiments with tow-nets have shown that life exists in all the intermediate waters of the ocean, between the surface and the bottom, yet sparingly there when compared with what occurs just above the bottom, or more markedly when compared with the abundant and luxurious development of life in the surface and sub-surface waters.

In mid-ocean the majority of the organisms are quite distinct from those usually found along the coasts in bays and estuaries, though, like the deep-sea animals, they were, in all probability, originally derived from the shallow waters around the continents. There are species of diatoms, calcareous and other algæ, many foraminifera, siphonophora, a few annelids, many crustaceans, numerous pteropods, heteropods, and other molluscs, the pelagic tunicates, and many fishes whose home is in the great systems of oceanic currents. It is only occasionally, or in special localities, that some of the species are borne to continental shores, for the members of this oceanic pelagic fauna and flora appear to be killed off where the ocean is affected by the fresh waters from the land. In the equatorial regions the species and individuals are most abundant, and they vary with temperature, latitude, and the salinity of the water.

In the Antarctic or Southern Ocean diatoms abound at the surface, and in the same region the sea-floor is covered with their dead siliceous frustules, which form a *diatom ooze*. In the middle and western Pacific, where the surface water is less salt than in the Atlantic, the radiolarians, which likewise secrete silica from sea water, occur in vast numbers at the surface and in intermediate waters, and in these regions their dead shells and skeletons make up the chief part of the deep-sea deposits, known as *radiolarian ooze*.

But it is those species belonging to the varied pelagic oceanic organisms which secrete lime for their shells and skeletons that are principally forced on our attention, both from their prodigious numbers and the part played by their remains in the formation of deposits. These species flourish especially in the warmest and saltest waters. In a square mile of equatorial water 600 feet deep it is estimated that there are over 16 tons of carbonate of lime in the form of shells, which belong to about 30 species of calcareous Algæ, Foraminifera, Pteropods, and Heteropods. When these surface organisms die and fall to the bottom they form the deposits known as *pteropod* and *globigerina oozes*. In descending they, as well as other surface organisms, carry down with them some of the organic matter of their tissues, which, not decomposing rapidly in the cold deep water, forms the chief source of nourishment for deep-sea animals, and the chlorophyll which Prof. Hartley has discovered in some deep-sea deposits is probably derived from diatoms which have fallen to the bottom in this way.

It is, however, a very remarkable fact that the dead shells of these Foraminifera and Pteropods are not found on the bottom of the sea beneath all the regions where they flourish abundantly at the surface. They are found at greater depths beneath warm equatorial waters than elsewhere, but there is barely a trace of them in all the greatest depths, although in an adjacent area, where the surface and intermediate conditions are the same, but where the depth [illegible] less than three miles, they may make up 75 or even [illegible] of the deposit. It has been abundantly proved that [illegible] ially sea water containing absorbed [illegible] shell or coral, the lime [illegible] as bicarbonate [illegible] rapidly the [illegible] the [illegible] bottom. Where the depth is not very great only the thinnest and most delicate shells are removed, and the others accumulate, forming vast deposits; with increasing depth other shells disappear, only the thicker ones reaching the bottom; but in the very greatest depth nearly every trace of these surface shells is removed, or we find them making up but 1 or 2 per cent. of the deposit. It is possible that this process of solution of the shells may be somewhat accelerated in the deepest layers of water by the great pressure.

In the deepest parts of the abysmal areas, where the carbonate of lime shells are either wholly or partially removed from the bottom, there are met with those peculiar deep-sea clays, the origin of which has been the subject of considerable discussion. They are principally made up of clayey matter resulting from the disintegration of volcanic rocks, and derived chiefly from floating pumice and showers of volcanic ashes. Mixed up with these clayey and volcanic materials are thousands of sharks' teeth, some of them of gigantic size, and evidently belonging to extinct species, also very many ear-bones, and a few of the other bones of whales, some of them also probably belonging to extinct species. These organic fragments are generally much decomposed and surrounded and infiltrated by depositions of peroxide of manganese, which is a secondary product arising from the decomposition of the volcanic material in the deposits. Again, we have in some places numerous zeolitic minerals and crystals formed in the clay, also as secondary products. Lastly, there are numerous minute spherules of native iron and other rare substances, covered with a black coating of oxide, which are referred with great certainty to a cosmic origin—probably the dust derived from meteoric stones as they pass through the higher regions of our atmosphere. Quartz, which is so abundant as a clastic element in deposits around the continents, is almost absent from the deposits of the abysmal regions.

In the abysmal regions, then, which cover one half of the earth's surface, which are undulating plains from two to five miles beneath the surface of the sea, we have a very uniform set of conditions: the temperature is near the freezing point of fresh water, and the range of temperature does not exceed 7°, and is constant all the year round in any one locality; sunlight and plant-life are absent, and although animals belonging to all the great types are present, there is no great variety of form nor abundance of individuals; change of any kind is exceedingly slow. In the more elevated portions of the regions the deposits consist principally of the dead shells and skeletons of surface animals, in the more depressed ones they consist of a red clay mixed with volcanic fragmental matter, the remains of pelagic vertebrates, cosmic dust, and manganese iron nodules and zeolitic crystals, the latter being secondary products arising from the decomposition of the minerals which have long remained exposed to the hydrochemical action of sea-water. The rate of accumulation is so slow in some of these clays that we find the remains of tertiary species lying on the bottom alongside the remains of those inhabiting the present seas. It has not yet been possible to recognise the analogues of any of the deposits now forming in the abysmal regions in the rocks making up the continents.

It is quite otherwise in the areas bordering the continents—the uncoloured areas on the maps. Almost all the matter brought down to the ocean in suspension is deposited in this region, which is that of variety and change with respect to light, temperature, motion, and biological relations. It extends from the sea-shore down, it may be, to a depth of three or four miles, and outwards horizontally from 60 to 300 miles, and includes all partially inclosed seas, such as the North Sea, Mediterranean, Caribbean, and many others. The upper or continental margin of the area is clearly defined by the coast line, which is continually changing from breaker action, elevation, and subsidence; the lower or abysmal margin of the region is less clearly marked out, passing insensibly into the abysmal regions and terminating where the mineral particles from the neighbouring continents disappear from the deposits. In the surface waters the temperature varies from over 80° in the equatorial to 28° in the Polar regions, and from the surface to the ice-cold water at the lower margins of the regions there is in the tropics an equally great range of temperature. Plants and animals flourish luxuriantly near the shore, and animals extend in relatively great abundance down to the lower limits of the region. Here we find now in process of formation deposits which will form rocks similar to those making up the great bulk of continental land, such as schists, shales, sandstones, marls, greensands, and chalks; the glauconitic grains of the green muds and phosphatic nodules can be traced in all stages of formation, and probably, though much less certainly, the initial stages in the formation of flint.

Throughout all geological time the deposits formed in this border or transitional area appear to have been pushed, forced, and folded up into dry land, through the secular cooling of the earth and the necessity of the outer crust to accommodate itself to the shrinking solid nucleus within. These depositions do not in themselves cause elevation or subsidence, but most probably the changes of pressure, resulting from them, tend to destroy the existing equilibrium and to produce lines of weakness along the borders of the continents and in the regions of enclosed and partially enclosed seas, with the result that the borders of continental land have been more frequently thrown into folds and have suffered greater lateral thrusts than any other regions on the surface of the earth.

On the other hand, while we know that there are vast deposits of carbonate of lime taking place over some portions of the abysmal regions, and that volcanic outbursts occur in others, still these are not comparable with the great changes which have taken place in the past, and are now taking place, on the continents and along their borders.

When the coral atolls and barrier reefs which are scattered over the tropical regions of the great oceans are examined in the light of recent discoveries, it is found that their peculiar form and structure can be accounted for by the truncation of some submarine cones through breaker action; by the upward growth of others through the accumulation of marine deposits; by the solution of dead coral through the action of sea-water; and lastly by a study of the source and direction from which the food supply reaches the reef-building animals. That this in all probability is the true history of the origin of these marvellous structures is further confirmed by the recent examination of the upraised coral atolls of the Pacific by Dr. Guppy, and the researches of Mr. Buchanan into the characters of oceanic banks and shoals. Coral atolls and barrier reefs, instead of pointing out great and general subsidences, must be regarded rather as indicating areas of great permanence and stability.

The results of many lines of investigation, then, seem to show that in the abysmal regions we have the most permanent areas of the earth's surface, and he is a bold man who still argues that in Tertiary times there was a large area of continental land in the Pacific, that there was once a Lemuria in the Indian Ocean, or a continental Atlantis in the Atlantic.

In this rapid review of recent oceanographical researches my chief object has been to show you the wide range of the observations, for every science has been enriched by a large store of new facts. It matters little whether the opinions which I have given as to the bearing of some of these be correct or not; for the observations are now or will soon be in the hands of scientific men, and errors in interpretation or deduction will soon be exposed. The great point is that there has been a vast addition to human knowledge, and it must be a matter of satisfaction that our own country has taken so large a share in these important investigations as to call forth the admiration of the scientific men of all countries. You have learnt from the President's address that there is usually not much to say in commendation of the Government for its liberality to science. But in the matter of deep-sea investigation, neglecting mere details, we can say that the successive Governments of the Queen during the past twenty years have, either from design or by accident, undertaken a work in the highest interests of the race, have carried it on in no mean or narrow patriotic spirit, and are likely to carry it to a termination in a manner worthy of a great, free, and prosperous people.

## *ON A SUPPOSED PERIODICITY OF THE CYCLONES OF THE INDIAN OCEAN SOUTH OF THE EQUATOR*[1]

IN papers printed in the *Reports* for 1872, 1873, 1874, and 1876, I endeavoured to show that there were grounds for supposing that the cyclones of the Indian Ocean south of the equator increased in number, extent, and intensity from a minimum in one year to a maximum in another, and then decreased to a minimum, the period or cycle apparently corresponding with the eleven-year period of solar activity.

From the data given in the last of these papers (*Report* for

[1] Paper by Mr. Charles Meldrum, F.R.S., read at the British Association.

1876, p. 267), it would appear that from 1856 to 1875 the years of minimum cyclone activity were 1856 and 1867, and the years of maximum activity 1861 and 1872, but that the results for each of those years did not differ much from the results for the year immediately preceding or following it, the variation near the turning-points being small.

Before giving a brief outline of the results which have been obtained since 1875, it may be well to mention that the sources of information were the same as in former years. Two clerks were constantly occupied in tabulating the meteorological observations contained in the log-books of vessels that arrived in the harbour of Port Louis from different places. The number of days' observations tabulated in each year—that is, observations extending over twenty-four hours and made in different parts of the ocean—was as follows:—

| Years | Days' Observations | Years | Days' Observations |
|---|---|---|---|
| 1876 | ... 17,017 | 1881 | ... 16,473 |
| 1877 | ... 17,005 | 1882 | ... 15,089 |
| 1878 | ... 17,050 | 1883 | ... 16,930 |
| 1879 | ... 15,889 | 1884 | ... 16,700 |
| 1880 | ... 17,306 | | |

The tables give an average of 46 observations of 24 hours each for every day of the nine years over the frequented parts of the ocean.

All details and reports respecting hurricanes, storms, or gales were recorded in separate registers.

For each day on which there was a gale in any part of the ocean between the equator and the parallel of 34° S. a chart was prepared, showing as nearly as possible the positions of the vessels the direction and force of the wind, &c., at a certain hour, namely, noon on the meridian of 60° E.

From these synoptic charts the details given from hour to hour in the log-books, and all the information obtained from other sources, the position of the centres of cyclones at noon on each day were determined, and the tracks laid down on separate charts.

Nine cyclone-track charts have thus been prepared, namely, one for each of the years 1876-84.

These track-charts, together with the twenty that had previously been prepared for the years 1856-75, show, as far as has yet been ascertained, the tracks of the cyclones of the Indian Ocean south of the equator in each of the years 1856-84, and the tracks for the years 1848-55 are nearly ready.

With respect to the period 1876-84, the *areas* of cyclones and the *distances* traversed have not yet been determined, but upon the whole the *number* and *duration* of the cyclones decreased to a minimum in 1880, and then increased till, in 1884, they were more than double of what they were in 1880.

From the accompanying track-charts for the eleven years 1856, 1857, 1860, 1861, 1867, 1868, 1871, 1872, 1879, 1880, and 1884, it will be seen that the number and duration of the cyclones of 1856 and 1857 were much less than those of the cyclones of 1860 and 1861; that the number and duration of the cyclones of 1867 and 1868 were much less than those of 1860 and 1861 on the one hand, and also than those of 1871 and 1872 on the other; and that the number and duration of the cyclones of 1879 and 1880 were much less than those of the cyclones of 1871, 1872, and 1884.

It would appear, however, that in 1884 there was less cyclone activity than in 1861 and 1872.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The commencement of Michaelmas Term does not witness many changes in the *personnel* of scientific departments in Oxford. A lecturer in Human Anatomy has been appointed, and commences work this term. The opening of the new physiological laboratories at the back of the University Museum completes the scheme for physiological education which has been so strenuously opposed by the enemies of scientific research in the University.

One of the most noticeable changes in Oxford to outward view is the opening of the new buildings in Trinity College. The new block of buildings, designed by Mr. Jackson, stretches backward from Kettle Hall in Broad Street to the Bathurst building and college chapel, making a new quadrangle bounded on the south by Broad Street and Trinity Cottages (now thrown into the "quad"), on the west by Balliol, on the north by the chapel and Bathurst, and to the east by the new buildings. The new "quad" is only second in size to "Tom quad" in Christchurch.

With our respect and sorrow for Dr. Bulley, late President of Magdalen, who died during the vacation, is mingled a feeling of intense satisfaction and not a little surprise at the appointment of his successor.

In Mr. T. H. Warren, the new President, Magdalen has gained a man no less distinguished for his scholarship than for his liberal views on education. Under the virile direction of her new president, Magdalen, already prominent among our Colleges for her recognition of natural science, may well hope to extend her usefulness. In the liberal Oxford of to-day—in the teaching as opposed to the voting University—Mr. Warren's election has been received with enthusiasm.

The following courses of lectures and classes in Natural Science will be given during the ensuing term:—In the Physical Department of the Museum Prof. B. Price lectures on Hydro-Mechanics. Prof. Clifton lectures on Ohm's Law; Mr. Selby lectures on Electrostatics; and Mr. Walker on Elementary Mechanics. The laboratory is open for practical instruction daily.

At the University observatory Prof. Pritchard gives three courses. Firstly, on the Application of the Theory of Probabilities to Astronomical Observation; secondly, on Spherical Astronomy; thirdly, on the Astronomy referred to by Polybius and other classical writers.

At Christchurch Mr. Baynes lectures on Conduction of Heat, and has a class for practical Instruction in Electrical Measurements.

At Balliol Mr. Dixon lectures on Elementary Magnetism and Electricity.

In the Chemical Department Prof. Odling lectures on the Phenic Compounds; Dr. Watts gives a course on General Organic, and Mr. Fisher gives a course on General Inorganic Chemistry.

The laboratories are open daily for practical instruction.

At Christchurch Mr. Vernon Harcourt has a class for Quantitative Analysis.

In the Biological Departments Prof. Moseley lectures on the Comparative Anatomy of the Vertebrata; Mr. Spencer lectures on Elementary Animal Morphology.

Prof. Burdon-Sanderson lectures on the Physiology of Motion, Mr. Dixey lectures on Histology, and Mr. Thomson on Human Anatomy.

The Morphological and Physiological Laboratories are open daily for practical instruction.

Mr. Jackson lectures on Parthenogenesis, Mr. Thompson on Osteology, and Mr. Poulton on the Distribution of Animals.

Prof. Westwood lectures on the Orders of Winged Arthropoda. Prof. Prestwich lectures on Geology: Physical Questions, Volcanic Action, &c.

At the Botanic Garden Prof. Gilbert lectures on the Results of Field Experiments, and Prof. Balfour gives practical instruction in Vegetable Morphology and Physiology.

Dr. Tylor lectures at the Museum on Social and Religious Systems.

## SCIENTIFIC SERIALS

THE only structural paper in the August and September numbers of the *Journal of Botany* is by Mr. Thomas Hick, on the caulotaxis of British Fumariaceæ. "Throughout the whole of this order," he states, "as represented in the British Isles, a remarkable unity of organisation prevails. In all cases, save that of *Corydalis solida*, the main stem is a sympodium or pseudaxis, composed of binodal caulomeres, except in the basal region, where they are of a higher order and often in the apical region also, where they become uninodal." The paper is illustrated by woodcuts. In addition the student of descriptive botany will find two papers by Mr. J. G. Baker: a monograph of the genus *Gethyllis* (with two plates), and a synopsis of the Cape species of *Kniphofia*, in addition to a continuation [illegible] synopsis of the genus *Selaginella*; and the numbers [illegible] wanting in other papers of interest in descriptive, sy[illegible] and geographical botany.

THE number for October is an unusually interesting [illegible] H. N. Ridley gives descriptions and figures of two [illegible] tions to the British flora, both belonging to [illegible] both from Scotland: *Schænus ferr*[illegible] discovery of the former genus [illegible] includes two are natives of the [illegible] of Australia and [illegible] are now known in [illegible] monograph of [illegible] —In addition to smaller [illegible] Carruthers' report on [illegible] the British Museum valuable notes on the [illegible], extracted from the [illegible]

[illegible] September.—Transport [illegible] and [illegible] transformers [illegible] [illegible] the raised against [illegible] electricity, by Prof. [illegible] of the electric [illegible] nitrous ethers of the [illegible] of the

[illegible] fasc. 2, 1885.— [illegible] institution of Society, [illegible] of the numbers of [illegible] the question of a [illegible] [illegible] have existed in [illegible] M. de Nadaillac [illegible] and considers it [illegible] assigned [illegible] where they [illegible] of the great [illegible] which M. M[illegible] [illegible] Thomas W[illegible] deposits, and [illegible] no way [illegible] [illegible] the [illegible] horse [illegible] M. [illegible] Egypt [illegible] [illegible] of mixed [illegible] Dr. Lanvel[illegible] anthropological [illegible] of French [illegible] and [illegible] of New Caledonia [illegible] [illegible] half [illegible] [illegible] the [illegible] [illegible] of muscular fi[illegible] anomalous muscle [illegible] of a [illegible] man aged [illegible] [illegible] of the foot, [illegible] atavism.—On [illegible] by M. [illegible] Blanchard.—The the influences of [illegible] of a muscular [illegible] On sterility [illegible], by the Mar- [illegible] Santa, collected [illegible] comparative analysis [illegible] Ten Kate.

*Revue d'Anthropologie*, tome 8ème, 3ème fascic., Paris.—On the weight of the cerebral lobes, according to Broca's register, by Dr. Philippe Rey. The data on which Dr. Rey's tables are based were obtained from 347 subjects, of which 231 were men and 116 women. On examining the means the figures yielded for the several lobes, without reference to sex or stature, it is found that while the total weight of the right hemisphere predominates over that of the left, the left frontal is heavier than the right, this difference amounting to 1·6 gr. on the total of 231 cases. This excess of weight of the left frontal had been noted by Broca, who believed it to be due to the influence of the third convolution. The right occipital is, on the other hand, [illegible] heavier than the left. The difference of weight for the entire [illegible] region between men and women amounts to 60·65 gr., which constitutes a large proportion of the general cerebral excess of weight in the male sex. The weight of both hemispheres is at its maximum between the ages of 25 and 35 years, although this period is generally reached earlier in women than in men, owing apparently to the more rapid evolution in the former of some one of the lobes. Loss of weight is most marked between 55 and 75 years, when it may amount to 62 grammes.—Anthropometric instructions for travellers, by Dr. Paul Topinard. The writer, after considering the true significance of the loosely applied term "race," and pointing out the importance of accepting one uniform and fixed system of anthropometric measurement, proceeds to describe the nature and mode of application of the various instruments indispensable for the attainment of trustworthy and available results. These admirable instructions are rendered specially serviceable through the addition of numerous comparative tables, including a useful schematic representation of the means of the measurements obtained for the European male adult when taken in proportion with the mean stature, which is estimated at 100. This code of instructions ought to be in the hands of all travellers able and willing to contribute towards the general mass of our anthropological knowledge, and its translation into our own and other tongues would be a gain to science. Numerous diagrams illustrate the way in which the instruments should be used, and the positions of the body best [illegible] for the purpose of each special observation.—On atavism [illegible], by Dr. R. Blanchard. The author considers that as the greater number of the teratological conditions observable in [illegible] may be explained by the persistence of some embryonic condition which is normally of a transitory character, we [illegible] to atavism for an explanation of such anomalies. Beginning with the cranium, Dr. Blanchard shows that microcephaly and [illegible] abnormal deformities must be characterised as [illegible] [illegible], the mean cranial capacity of civilised races [illegible] [illegible] augmented within the last few centuries, [illegible] that the cranial capacity of the gorilla, or chimpanzee, which is more than five times less than the mean given for Parisians of the present day, is only slightly in excess of that observed in microcephalic subjects. After [illegible] to review the various anomalies to be met with in [illegible], and pointing out their analogues in the normal anatomy of the lower animals, he proceeds to the [illegible] system, in which the writer shows that supernumerary [illegible] three or four times in every hundred cases. This [illegible] of the subject is, however, only briefly touched on in [illegible] of the exhaustive work of M. Testut bearing on the [illegible], and to this the student is referred. Finally, after considering the comparative history of the development of the [illegible], and of the embryo of some of the lower animals, [illegible] by drawing attention to the importance of studying the normal anatomy of the lower animals, more especially of [illegible], marsupials, and lemurians, if we desire to elucidate the origin and development of the various anomalies presented by the human organism.—On Broca's method of estimating the capacity of the cranium, by M. P. Topinard. The writer gives [illegible] description of the instrument to be used and the [illegible] to be followed in the process, together with tables showing the various results that had been yielded by Broca, Ranke, and others when lead, glass beads, or millet seed had been used as the agent for gauging the capacity.

## SOCIETIES AND ACADEMIES

### SYDNEY

**Linnean Society of New South Wales**, June 24.—The following papers were read:—Rough notes on the natural history of the Claremont Islands, by Gervase F. Mathew, R.N. Mr. Mathew gives an interesting account of the fauna and flora met with on these islands, in which he enumerates 23 species of birds and 20 species of *Lepidoptera*, of which 2 *Lycaena* are probably new. He also gives some notes on the habits of each species enumerated.—An afternoon among the butterflies of Thursday Island, by Gervase F. Mathew, R.N. Mr. Mathew gives an account of a few hours' ramble on Thursday Island, resulting in the capture of 48 species of diurnal butterflies. He gives a detailed description of the larva of *Ornithoptera pronomus*. He also makes brief mention of the flora and physical geography of the island.—New fishes from the Upper Murrumbidgee district, by William Macleay, F.L.S. Two new fishes are here described, and two others, probably new, are noticed. The new ones are a species of *Murrayia*, from the Murrumbidgee, near Yass, and a very blunt-headed species of *Oligorus* from the same locality. The two fishes alluded to as probably new are a species of *Gadopsis* from the Little River and a *Galaxias* from Yass River.—On a new *Diplocrepis*, by J. Douglas Ogilby. Mr. Ogilby describes, under the name of *Diplocrepis costatus*, a species differing considerably from *D. puniceus* of Richardson, and he points out that the fish is more nearly allied to the New Zealand genera, *Diplocrepis* and *Trachelochismus*, than to the Australian genera, *Crepidogaster*.—Jottings from the Biological Laboratory of Sydney University, by William A. Haswell, M.A., B.Sc., Lecturer on Zoology and Comparative Anatomy.—On a destructive parasite infesting the oyster. Specimens of diseased oysters from the Hunter River beds were found to have their shells perforated and destroyed by a small boring annelid—*Leucodore ciliata*—which, by burrowing through the substance of the shell, causes the disintegration of the valves and the death of the oyster.—On some recent histological methods and their application to the teaching of practical histology.—On the minute structure of *Polynoe*.

PARIS

**Academy of Sciences**, October 12.—M. Bouley, President, in the chair.—The President announced the death on October 6, at Jasseron (Ain), of the eminent histologist, M. Ch. Robin, Member of the Section for Anatomy and Zoology.—Memoir on the botanical work of the late M. Charles Edmond Boissier, who died at Valleyres, Canton of Vaud, on September 25, by M. P. Duchartre. Born at Geneva, in 1810, of a French Huguenot family, M. Boissier first devoted his attention to the Swiss Alpine flora. But he will be remembered chiefly for his explorations in the Iberian peninsula (Grenada, Sierra Nevada, &c.) in 1837, and in the Levant (Greece, Anatolia, Syria, Egypt, &c.) in 1842-46. The results of his labours in these botanical regions are embodied in his "Elenchus plantarum novarum minusque cognitarum quas in itinere hispanico legit" (Geneva, 1838); "Voyage botanique dans le midi de l'Espagne pendant l'année 1837" (Paris, 1839-45); and "Flora orientalis, sive enumeratio plantarum in Oriente a Græcia et Egypto ad Indiæ fines hucusque observatarum," five large volumes, 1867-1884.—On the neutralisation of the aromatic acids, by M. Berthelot. The results are here given of experiments made on mellic acid, $C_{24}H_6O_{24} = 342$; meconic acid, $C_{14}H_4O_{14}, 3H_2O_2 = 254$, and acrylacetic acid, $C_4H_4O_2(C_4H_6O_4) = 114$.—On sundry phenols, by M. Berthelot. The author here passes from the study of normal phenol to that of its homologues, the cresylols and ordinary thymol, as well as the naphtols or phenols derived from naphtaline.—Note on the first volume of the *Annales de l'Observatoire de Bordeaux*, issued by M. Rayet, and presented to the Academy by M. Lœwy. Besides a full account of the foundation of the Bordeaux Observatory in 1871 and of the instruments employed in it, this volume contains all the magnetic and meteorological observations taken in 1880-81 and some of the results of the work begun in 1885 for the purpose of determining the co-ordinates of 23,000 stars in the Southern Hemisphere between – 15° and – 30°, already observed by Argelander at the Bonn Observatory in 1850.—Effects of mildew on the vine as shown by a comparison of the plants successfully treated with a mixture of lime and sulphate of copper by M. Nath. Johnston in the Médoc district, with plants in the same district attacked by the disease and left untreated, by MM. Millardet and Gayon.—Observations on the nature of inverted sugar and of elective fermentation, by M. E. Maumené. Further experiments confirm the conclusion already arrived at that M. Leplay's theory of elective alcoholic fermentation is based on erroneous assumptions.—Note on the constant presence of *Amœba coli* in dysenteric secretions, by M. A. Normand.—Observations on Palisa's new planet 251, made at the observatory of Paris (equatorial of the west tower), by M. G. Bigourdan.—Observations of Brook's comet and of Palisa's new planet 251, made at the Observatory of Algiers with the 0·50 m. telescope, by M. Rambaud.—Researches on vanadium: properties of vanidic acid, by M. A. Ditte.—Kinematic analysis of the locomotion of the horse by means of M. Marey's chronophotographic apparatus, five illustrations, by M. Pagès. In this paper the author explains and illustrates the trajectory and velocity of the foot and pastern in the three principal actions of the horse—the step, trot, and gallop.—Note on the internal phenomena of muscular contraction in the primitive striated fasces, by M. F. Laulanié.—On the physiological action of the salts of lithium, potassium, and rubidium, by M. Ch. Richet. The mean toxic dose with the chlorides of these alkaline metals has been determined for the tench, frog, pigeon, rabbit, and some other organisms.—On the development of Fissurella, by M. L. Boulan. From a study of the biological evolution of this organism the author concludes that it is a true gasteropod, and cannot, therefore, be grouped with the order of worms; further, that the apparent symmetry of the adult Fissurella is, in reality, a disguised progressive asymmetry.—Influence of salt water on the development of the larvæ of the frog, by M. E. Yung. The tadpole perishes in three to twenty minutes in the water of the Mediterranean containing 4 per cent. of salts, and in a few hours in a solution of marine salts in the proportion of 1 per cent. But it may be adapted to this element by a gradual preparation through a progressive series of solutions from 2 to 8 per 1000.—On the apparent rotatory movement of balloons recorded by aeronauts, by M. G. Tissandier.—Memoir on the fermentation of bread-stuffs in connection with M. Aimé Girard's communication on this subject, by M. G. Chicandard.

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

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THURSDAY, OCTOBER 29, 1885

## *THE ANTI-CHOLERA INOCULATIONS OF DR. FERRAN*

IN the spring and summer of the present year the public in Europe—lay and medical—have been greatly agitated by the exploits of a Spanish medical gentleman, who, during the cholera epidemic then raging in Spain, claimed to have discovered a means of preventing cholera. He was hailed as a great benefactor, and if his deeds had been equal to his professions, he would no doubt fully deserve to rank with Jenner, the greatest benefactor to mankind. But fortunately the medical world, at any rate the scientific medical world outside Spain, is not guided by the allegations of enthusiasts nor by wonder-doctors either. A Don Quixote, who discerns in a windmill giants, in a flock of sheep a squadron of the enemy's soldiers, may present points of interest to the psychologist: to the disciple of physiology and pathology he demonstrates an aberration of the visual nerve centres. I shall show that Dr. Ferran comes very near in rank, not to Jenner, but to his own illustrious countryman, the Knight of La Mancha.

The method of Ferran is practically this:—Ferran says that by a peculiar mysterious method of cultivation—which for a long while he was not going to divulge—he has succeeded in attenuating the action of the comma bacillus of Koch. In these cultivations the comma bacillus after very complex morphological changes, unnecessary to detail here, forms spores. Such cultures introduced in sufficient quantities into the subcutaneous tissue of animals (guinea-pigs) or man produce a disease which is a mild and abortive form of cholera; it manifests itself in local inflammation, and a general constitutional disturbance, febrile rise of the body temperature, headache, nausea, and sickness, and even diarrhœa. After a few days the person inoculated returns to his normal state. Persons once, twice, or thrice inoculated answer, or ought to answer, each inoculation with the said constitutional disturbance. Statistics collected by Ferran and his adherents in the places where these inoculations were practised, notably in Alcira, in and about Valencia, prove, so it is said, that the number of cholera cases and of deaths from cholera decreased in a conspicuous degree after these inoculations had been commenced, and also that those persons that had been inoculated remained almost impervious to cholera, while others not so inoculated fell victims to the plague in large numbers. In these assertions and practices several important questions are involved, each of which demands a direct answer, which ought to be favourable to this theory of Dr. Ferran.

First: Is the so-called cholera-bacillus, or Koch's comma-bacillus, found in the intestinal discharges of cholera patients, the *vera causa* of cholera?

Second: Does this so-called cholera-bacillus form spores, which when introduced into the living tissue germinate into the comma bacilli: in the subcutaneous tissue capable of producing only an abortive and mild form, but in the alimentary canal producing severe and malignant cholera?

Third: Do the cultivations of Dr. Ferran, when inoculated into the subcutaneous tissue, set up a disturbance which can be considered as an abortive form of cholera?

Fourth: Are persons so inoculated really protected or almost protected against an attack of real cholera; and do the statistics collected by Ferran and his adherents prove this?

(1) The first of these questions, it is obvious, forms the basis of the whole theory; for if the comma bacillus of Koch is not the real cause of cholera all the rest of Ferran's assertions, as far as cholera is concerned, fall to the ground. The claims of the comma bacillus of Koch to be accepted as the true cause of cholera, rests on very insufficient evidence: the epidemiological evidence as to the spread of cholera being dependent on soil and season, the anatomical evidence as to the comma bacilli being limited to the cavity of the cholera intestine, they being absent from the tissues and the blood, the misproportion existing between the number of comma bacilli present in the alimentary cavity, and between the severity and acuteness of the disease in many cases, and a number of other facts not necessary to mention here, prove to my mind that the comma bacillus is not the real cause of cholera. Add to this that Emerich of Munich vindicates this claim to be the real cause of cholera, not to the comma bacilli of Koch, but to small straight bacilli, probably identical with those seen and described by the English cholera Commission in India as constantly present in the alimentary canal of cholera patients, and for which bacilli I did not and cannot claim any real infective power; and further, that Emerich's view is backed up by no less an authority than Von Pettenkoffer himself. There is then at present an interesting contest going on between two rival bacilli: one, having Berlin for the head-quarters of its advocates, may be called the northern bacillus; the other, in Munich, may be called the southern bacillus. As to the actual facts, it seems to me the question is not whose claim is stronger, but whose claim is weaker.

(2) All except Ferran, acquainted practically with the comma bacillus in pure cultivations (Koch, Van Ermengem, myself, Mr. Watson Cheyne, Finkler, Emerich, Buchner, Klebs, and many others) are agreed that the comma bacillus in artificial cultivations never forms spores; having multiplied until all the nutritive material in the cultivation is exhausted, a period arrives when the comma bacilli degenerate and die; some undergo this long before the point of exhaustion is reached, others retain their vitality longer, but after weeks and months death has involved all the comma bacilli present in the cultivation. [An impurity accidentally present in the culture would effect this death of the comma bacilli in a much shorter period; in fact, in many instances, they would not have much chance of primarily reaching any considerable number.]

When this period has been reached, the culture becomes incapable of starting a new culture; and *vice versâ*: by this means the point of death of the bacilli present in the culture can be tested and accurately determined. I have a large number of tubes of pure cultivations of the comma bacilli, the nutritive medium being broth, or peptone and broth, or gelatine peptone and broth, or gelatine peptone and meat extract, or Agar-Agar peptone and broth, &c. In each of these media the comma bacilli thrive well and form copious growths. The cultures are pure, contain the comma bacilli only, as all sub-cultures from them yield again the comma bacilli, and comma bacilli only. Now the remarkable fact about such culture tubes is this: that after several months all life in them becomes extinct, as is proved by inoculating from them a series of tubes containing suitable nutritive material, no comma bacillus or any other bacteria making their appearance. I have ascertained this in a great many cases, and it is in perfect agreement with the experience of Koch and many other workers. This clearly proves that there are not present in such tubes spores of the comma bacilli, for, if the comma bacilli, like some other bacilli—*e.g.* bacillus subtilis of hay infusion, or bacillus anthracis, were capable of forming spores, such a total extinction of life could not take place: the spores, although, owing to exhaustion of nutritive material, incapable of germinating into bacilli while in the tube in which they were formed, would undoubtedly germinate when transferred into a fresh and suitable nutritive medium. This total extinction of life does occur not only in tubes in which the nutritive medium is in a fluid condition, but also in all Agar-Agar peptone broth tubes, this material, unlike gelatine, remaining in its solid state, however luxuriant the growth of the comma bacilli may be.

Dr. Ferran claims to have discovered means by which the comma bacilli can be made to produce spores. In his cultures he notices a number of peculiar things which he considers as antecedents to the formation of spores and as fully formed spores. But direct observations that these are really spores, that, like spores, they actually germinate into the bacilli, Dr. Ferran has not deemed it necessary to make. As a matter of fact those to whom Dr. Ferran has shown his specimens, in which these alleged spores were supposed to be present, failed to see them (see the Report of the French Commission headed by Dr. Brouardel; see also Dr van Ermengem's Report).

The methods of examination and cultivation of bacteria perfected by Koch, which, owing to the thoroughly reliable results they yield, are now universally followed by all who wish to acquire correct ideas and a sound knowledge of the life-history, morphology, and activity of bacteria, have led those practically acquainted with the comma bacilli to the conclusion that they do not form spores. Dr. Ferran is of the contrary opinion; but, judging from the Report of the French Commission, and from that of van Ermengem and others, who have visited Ferran and seen him at work, it is pretty clear that this gentleman is not only unpractised in, but altogether unacquainted with the elements of technique necessary in bacterial investigations; more than this: according to a graphic description by the special correspondent of the *Times*, Dr. Ferran makes his cultivations in broth in a temporary laboratory, the kitchen of an untenanted house, reeking with the effluvia of an untrapped sewer opening into this kitchen. Dr. Ferran's cultivations [illegible] examined microscopically by a Valencia C[illegible] who found that they contained a motley crow[illegible] kinds of bacteria; Dr. Chantemesse in a [illegible] the Paris Académie de Médecine (see *Br*[illegible]

*Journal*, Sept. 26, 1885) states that as the result of a microscopic examination of Dr. Ferran's cultures he found the fluid variable in its composition; sometimes it is a cultivation of impure comma bacilli, sometimes it contains masses of different micro-organisms, but the comma bacilli are barely present. Add to this that Dr. Ferran, as the special French Commission attested, possesses neither the skill nor uses the ordinary precautions and apparatus indispensable in investigations of this nature, and all Ferran's extravagant assertions as to the behaviour of the comma bacillus in cultivations, as to its peculiar power of forming spores, must be regarded as sheer nonsense.

3. Notwithstanding this deficiency of Ferran in his mode of preparing his so-called "vaccine," it might be said, and it has been said by Dr. Cameron in a powerful and very able article in the *Nineteenth Century* for August 1885, that by subcutaneously inoculating a cultivation of comma bacilli, no matter however impure and contaminated, *e.g.* such as were at Ferran's disposal, the effect is different from the one produced by introducing them into the alimentary canal. In the former case, *i.e.* in the subcutaneous tissue, they are planted in a soil not congenial to them, and their product is only an abortive form of cholera, whereas in the latter, *i.e.* in the cavity of the alimentary canal, they find a more suitable soil, a soil which is their natural breeding ground, and the result is virulent real cholera.

What Ferran by the inoculation of his cultures into the subcutaneous tissue of human beings actually did produce, is, according to a number of witnesses (see the letters of the special correspondent of the *British Medical Journal*; the evidence given in detail by the special correspondent of the *Times*, October 20, and a number of other independent witnesses, English and French), septic infection, the intensity of which, as might be expected, and as Ferran himself admits, depends on the quantity injected. This result, however, is not always produced, the injection being sometimes quite inert, notwithstanding the presence of the comma-bacilli in the "vaccine" fluid. In the very able letter by the special correspondent of the *Times* for October 20 we are informed that Dr. Ferran explained to this gentleman in detail that the culture fluid used for inoculation need not contain any comma bacilli at all, in order to produce the desired result; further, that the comma bacilli can be killed by boiling or otherwise, without impairing the efficacy of the fluid, and that therefore a chemical substance present in the culture fluid, and probably the product of the organisms, must be regarded as the active principle. While this latest assertion of Ferran clearly shows that he is profoundly ignorant of the [illegible] and practice of protective inoculations, such as [illegible] by Chauveau, Pasteur, Koch, Gaffky, Arlo[illegible] and many others in a variety of sp[illegible] some fo[illegible] æmia, fowl [illegible] while it is in [illegible] an earlier date, it [illegible] Ferran by the inoc[illegible] subcutaneous ti[illegible] the assumption [illegible] as ptomaïnes, and produced by the growth and activity of putrefactive bacteria in media containing proteids. Brieger (" Die Ptomaine," Hirschwald, Berlin, 1885) has published a most important series of observations on the production, nature, and action of ptomaines, and has greatly enlarged our knowledge of this as yet obscure subject. The description of the symptoms observable on persons inoculated by Ferran (as given by a variety of independent witnesses and by Ferran himself), can leave little doubt that the result of these inoculations is septic poisoning, in severe cases dangerous phlegmon and ulceration, and even death. This is also the opinion of a number of medical men (Spanish, English, and French) who have had the opportunity of seeing and examining such persons, as will be seen from the Report by the Special Commissioner of the *British Medical Journal*, the Report by the Special Commissioner of the *Times*, the Report by the Special French Commission, and the Report of the Commission sent by the Spanish Government. Such being the case, the inoculations practised by Ferran and his coadjutors can have no possible prophylactic effect against cholera, even granting, for the sake of argument, that one mild attack of cholera protects against a second severe one, a question which is still *sub judice*, since some competent authorities maintain that such immunity, although holding good in a number of infectious maladies, does not apply to cholera.

4. Now, are persons inoculated by Ferran furnished with immunity against an attack of cholera? The statistics published by Dr. Ferran and his adherents on the marvellous effects of inoculation in Alcira, Valencia and other places, accepted by Dr. Cameron in his article above referred to, show us a picture of brilliant successes, favourably comparing and even surpassing the statistics of the effect of vaccination against smallpox. Those statistics collected by Ferran being endorsed by several medical men and other notabilities of the town of Alcira and elsewhere, Dr. Cameron cannot bring himself to regard as not revealing the truth; he cannot imagine that all these worthy people should conspire to pervert the truth and to prevent the truth from becoming known.

The correspondent of the *Times* in his letter, published October 20, gives a long list of places where the statistics published by the Ferranists are signed and stamped by the Alcalde of the place, the local judge, the priest, the resident doctors, and the notary; all duly signed and stamped. This Englishman, however, probably knowing what value to attach to the competency and veracity of all those worthies, examined the statistics for himself, and the result of his inquiry may be briefly summarised by saying that Dr. Ferran and his partisans have simply "cooked" those statistics. They have done these things: when a person who had been inoculated by Ferran did nevertheless become affected with cholera, and died of it, death was put down as caused not by cholera but by some other disease; false entries were made as to persons who, having been inoculated, nevertheless died of cholera, [illegible] not entered as having been inoculated; persons [illegible] been registered as having been "vaccinated" by [illegible] on inquiry were found to have died of cholera [illegible] previous to the alleged "vaccination."

[illegible] fact that in Alcira, for instance, the [illegible] wonderful effects had not commenced until the population had abandoned the impure water supply; that in some places many of the inoculated persons belonging to the well-to-do classes (a fee being paid for the inoculation) were therefore less exposed to infection, and those statistics become a gross farce and a shameless imposture. And this is practically the opinion of the Special Commission sent by the Spanish Government; this Commission has reported altogether unfavourably on these inoculations, declaring them barren of all scientific value, dangerous inasmuch as persons inoculated and suffering in consequence from a form of septic poisoning become more susceptible to infection from cholera and other diseases, and further condemning them as of no value in giving immunity against cholera.

The fact that Dr. Ferran and his associates took payment for the inoculations—thousands of persons were inoculated and reinoculated in Valencia and elsewhere, for each inoculation a fee of from 5 to 12 francs being charged—gives to the whole business a very ugly look. The *Times* correspondent (*Times*, October 20) does not therefore fully express the real value of Dr. Ferran when he says that he (Dr. Ferran) "is the dupe of illusions, conceived in ignorance." E. KLEIN

## *LIFE OF SIR WILLIAM ROWAN HAMILTON*

*Life of Sir William Rowan Hamilton, Royal Astronomer of Ireland.* By Robert Perceval Graves, M.A., Sub-Dean of the Chapel Royal. Vol. II. pp. 719. With Portrait. (Hodges, Figgis, and Co.)

IN a former number of this journal it was our duty to notice the first volume of the life of the illustrious Irish mathematician. We have now to congratulate Mr. Graves on the completion of the second instalment of that great work which has evidently been to him a labour of love. This volume, like its predecessor, bears abundant testimony to the conscientious manner in which the author has sought to delineate a picture of Hamilton, told as far as possible by the letters from Hamilton to his friends and by extracts from his journal. We are again surprised at the extraordinary copiousness of the materials which were available.

The incidents in the life of Hamilton apart from his literary and scientific activity are but few. The last volume conducted us to the year 1832, when Hamilton was in his twenty-seventh year. We had there seen the troubled course of his two earlier love affairs, and at the outset of this volume we are introduced to the third with Miss Bayly, to whom he was married in 1833. His domestic happiness was in the course of years clouded over by the ill-health of his wife, though to the end he remained an attached husband, as she was an attached wife; two sons and one daughter were the issue of this union.

The reader of this work can hardly fail to be struck with the number and the worth of the friends to whom Hamilton was endeared; he possessed to a remarkable degree the power of transforming a casual acquaintanceship into a true and lasting friendship. His intimacy with Wordsworth has been already referred to, and was carried on by occasional letters and visits until the death of the poet. Among his other literary friends we may mention Maria Edgeworth, who writes to him (p. 384):—

"Take your head from the stars or from transcendental mathematics and come and enjoy Folly and Friendship."

There are also copious letters to and from Aubrey De Vere, Lord Dunraven, the Marquis of Northampton, and many others, including not a few to his intimate friend the author of the present work; one of these we would specially mention (p. 357), in which Hamilton sketches the obligations of true friendship. The scientific correspondence of Hamilton with many of the leading philosophers of the last generation occupies, as might have been expected, a large proportion of the volume.

At successive meetings of the British Association Hamilton was a well-known and a conspicuous figure. When the Association visited Dublin in 1835 he was but thirty years old, yet he had already attained a scientific renown which made him perhaps the most eminent man at that meeting. It was on this occasion that the Board of Trinity College entertained the distinguished visitors at a banquet. The guests had assembled in the venerable library of the University. The Earl of Mulgrave, then Lord Lieutenant of Ireland, called Hamilton to the centre of a little circle, and, after conferring upon him the honour of knighthood, said:—

"I but set the Royal, and, therefore, the national mark on a distinction already acquired by your genius and labours" (p. 158).

In speaking at the banquet subsequently, Whewell said, in language which the enthusiasm of the moment might perhaps excuse:—

"It was now one hundred and thirty years since a great man in another Trinity College knelt down before his Sovereign and rose up Sir Isaac Newton" (p. 159).

In the year 1842 Sir R. Murchison, then general secretary of the Association, writes to Hamilton as follows (p. 387):—

"Your letter of the 16th having crossed mine, *I am in despair* at your resolution not to visit Manchester; and in order to shake it if possible, even at the eleventh hour, I enclose you a letter from Herschel, whose resolutions were quite as firm as yours, and who yet has made them fly before Bessel. Think of this philosopher coming on purpose to see such men as Herschel, yourself, and two or three others, and finding Airy and Baily flown to Italy and Sir William Hamilton *lecturing* in Dublin!! Pray put off your class for a week. Make a noble effort and lay it all on Bessel's shoulders, and you will add to your glory."

On this occasion Hamilton had also the gratification of meeting the great mathematician Jacobi, who, after referring to Hamilton as the "Lagrange of your country," said (p. 388):—

"Provided that we give to the dynamical equations that remarkable form under which they have been presented for the first time by the illustrious Astronomer Royal of Dublin, and in which they ought to be presented hereafter, in all the general researches of analytical mechanics."

We also read how Hamilton was received at the Oxford meeting in 1847, in which, to quote his own words from a letter to the author, he says (p. 585):—

"It has several times happened to me to sit between Struve and Le Verrier (both of whom, somewhat to my surprise, and certainly beyond my deserts, assigned me a high place among British astronomers in speeches at the concluding meeting). And when I give an account of the application of the calculus of quaternions to the theory of the moon on the Thursday of last week, and saw before me not only those two eminent foreign astronomers, but also Herschel, and Airy, and Adams, and Challis, besides Peacock and Whewell, and others scarcely less distinguished, I could not refrain from acknowledging it to be an alarming and almost an awful thing to speak on any subject of physical astronomy in the presence of such an audience."

Hamilton also records in an unsent letter the following, which refers to the same meeting (p. 585):—

"My friend Struve, of Russia, at Oxford, 1847, said: that, though I held the title of Royal Astronomer of Ireland, my astronomical brethren on the Continent would decidedly prefer my never looking through the telescope to my giving up or less ardently pursuing mathematics. 'You are,' he was pleased to say, 'our teacher.'"

Hamilton was for many years not only the most distinguished member of the Royal Irish Academy but also its president. Many interesting letters will be found in the volume relating to his election to this distinguished post. His rival, if so he can be called in what Hamilton describes as a "contest of generosity," was the late Provost Lloyd. Lloyd retired in favour of his friend, and Hamilton writes many letters, the character of which is fairly represented by one to Lloyd (p. 218), in which he disclaims

"Entertaining *even a thought* which could be construed into *treason* to our long and unclouded friendship, and that the part *you* have taken (while in some respects it adds to my pain) furnishes a new proof of the justice of the high opinion that I have ever entertained of you."

Hamilton discharged in the most exemplary manner the laborious duties of President for several years, until, as he writes (p. 510):—

"The day has at length arrived when I am to accomplish my desire of retiring from the chair of the R.I.A. How joyously, though not without a feeling of solemnity, I received the news of my being elected to the chair; how gladly now I resign it, yet not without a shade of that sadness which belongs to a farewell!"

The chief interest in this volume will be found in the account of the great invention of quaternions, with which the name of Hamilton will be for ever associated. His own appreciation of the importance of this achievement is shown in an extract from a letter to Prof. Lloyd in December, 1851 (p. 445):—

"In general, although in one sense I hope that I am actually growing *modest* about the quaternions, from my seeing so many peeps and vistas into future expansions of their principles, I still must assert that this discovery appears to me to be as important for the middle of the nineteenth century as the discovery of Fluxions was for the close of the seventeenth."

The account of the discovery which, after fifteen years of studious meditation, seems suddenly to have flashe[illegible] upon Hamilton is told in an interesting letter written fro[illegible] his deathbed [illegible] years later to his son Archiba[illegible] (August 5, [illegible]

"On th[illegible] 1843, which happened to be Mon[illegible] of the Academy, I was walking i[illegible] and your mother was walking wi[illegible] anal, to which she [illegible] ps [illegible] talked with me [illegible] hen, ye[illegible] ght was going [illegible] ind wh[illegible] hereof it is not too much to say that I felt *at once* the importance. An *electric* circuit seemed to close; and a spark flashed forth, the herald, as I *foresaw immediately*, of many long years to come of definitely directed thought and work, by *myself* if spared, and at all events on the part of *others*, if I should even be allowed to live long enough distinctly to communicate the discovery. Nor could I resist the impulse, unphilosophical as it may have been, to cut with a knife on a stone of Brougham Bridge, as we passed it, the fundamental formula with the symbols $i, j, k$;—namely, $i^2 = j^2 = k^2 = ijk = -1$, which contains the *solution* of the *problem*, but of course, as an inscription, has long since mouldered away. A more durable notice remains, on the council books of the Academy of that day—October 16th, 1843—which records the fact, that I then asked for and obtained leave to read a paper on *quaternions* at the *first general meeting* of the session, which reading took place accordingly, on Monday, November 13."

Among the most distinguished disciples of Hamilton is Prof. Tait, though *even he* has admitted that he has not read the whole of Hamilton's "tremendous volumes" (lives there indeed the man who has?). Another account of the discovery is found in a letter to Prof. Tait on October 15, 1858 (p. 435):—

"To-morrow will be the fifteenth birthday of the quaternions. They started into life full-grown on the 16th of October, 1843, as I was walking with Lady Hamilton to Dublin, and came up to Brougham Bridge—which my boys have since called Quaternion Bridge. I pulled out a pocket-book, which still exists, and made an entry, on which *at the very moment* I felt that it might be worth my while to expend the labour of at least ten or fifteen years to come. But then it is fair to say that this was because I felt a *problem* to have been at that moment *solved*, an intellectual want relieved which had haunted me for at least *fifteen years before*."

The unmathematical reader may naturally ask the nature of this notable discovery which Hamilton made at "Quaternion" Bridge.

It would seem that at this moment he solved the long-studied problem of the multiplication of directed straight lines, or vectors as he called them. Let $a$ denote a straight line of determined length and direction. Let $b$ denote another straight line at right angles to $a$, and radiating from the same origin; then the product $ab$ denotes a third straight line from the same origin perpendicular to the plane of $a$ and $b$; the product $ba$, however, denotes the perpendicular line on the other side of the plane, so that $ba = -ab$. This formula is eminently characteristic of the method, showing as it does that vector multiplication is non-commutative. It is, however, remarkable that the associative principle obtains in quaternions no less than in ordinary algebra; thus if $a, b, c$ be three vectors, or more, generally quaternions, then $ab \times c = a \times bc$. This theorem, though *true* in quaternions, is still so far from being obvious that it implies [illegible] truth of an elaborate geometrical theorem.

If w[illegible] single out one point of special significance in [illegible] quaternions it would be found in the *du*[illegible] of the symbol of a vector. Thus if the [illegible] vector or directed straight line of unit [illegible] same symbol may also mean an oper[illegible] rough a right angle around the vector [illegible] formulæ of quaternions the symbols [illegible] be interpreted in this dual manner. [illegible] e regarded as the operating factor wh[illegible] vector transforms it into another. This operation requires two quantities to specify the plane of the vectors—one to specify the angle between them and one the ratio of their lengths in all four quantities are required, whence the name quaternion.

An interesting letter (p. 536) to the Rev. John W. Stubbs, Fellow of Trinity College, dated October 19, 1846, gives a sketch of the points which Hamilton thought specially novel in his theory:—

"But did the thought of establishing such a system, in which *geometrically opposite factors*—namely, two lines (or areas) which are opposite IN SPACE give ALWAYS a *positive product*—ever come into anybody's head, till I was led to it in October, 1843, by trying to extend my old theory of algebraic couples, and of algebra as the science of pure time? As to my regarding *geometrical addition* of lines as equivalent *to composition of motions* (and as performed by the same rules), that is indeed *essential* in my theory, but *not peculiar* to it; on the contrary I am only one of many who have been led to this view of addition."

A few years later Hamilton commenced the delivery of lectures on quaternions in Trinity College. His own words are (p. 605):—

"It was on Wednesday, June 21, 1848, that I delivered my first lecture on quaternions to a very respectable audience, among the persons composing which were the Rev. George Salmon, Fellow of Trinity College, Dublin, and author of a lately-published treatise on Algebraic Geometry, and Arthur Cayley, Fellow of Trinity College, Cambridge, who first, except myself, has publicly used the quaternions."

These lectures, rewritten and greatly expanded, formed his first and classical volume—"Lectures on Quaternions." (Dublin, 1853.)

The publication of this work drew from Hamilton's many scientific friends cordial letters of congratulation. His old and intimate friend, Sir John Herschel, thus writes on July 21, 1853 (p. 681):—

"Now most heartily let me congratulate you on getting out your book—on having found utterance *ore rotundo* for all that labouring and seething mass of thought which has been from time to time sending out sparkles, and gleams, and smokes, and shaking the soil about you—but now breaks into a good honest eruption with a lava stream and a shower of fertilising ashes. I don't mean to say that there is not a good deal of cloud (albeit full of electric fire)—the good old 'stupendo e orgoglioso pino' of the fiery outbreak surrounding the bright jet, the true product—but the cloud clears as the wind drifts and leaves the hill conspicuous.

"Metaphor and simile apart, there is work for a twelvemonth to any man to read such a book, and for half a lifetime to digest it, and I am quite glad to see it brought to a conclusion."

The intercourse, both social and scientific, between Hamilton and Sir John Herschel gives many interesting pages to this volume. Thus, for instance, we find (p. 492) an account of a meeting between these philosophers at the house of their common friend, Dr. Peacock, the Dean of Ely. On Sunday they attended service in the Cathedral in company with Prof. James D. Forbes, and Hamilton recorded the incident in a sonnet which he recited to his friends. The next morning he received an acknowledgment in kind from Herschel. We quote here the two poems: that of Hamilton (p. 493) bears the title "In Ely Cathedral":—

"The sunshine, through the lofty window stealing,
Lit up that vast and venerable fane,
Ely's Cathedral, in dark clouds and rain
Wrapped lately, and shut up from joyous feeling:
In its soft progress all around revealing
Beauty or majesty unmarked before,
It shed its type of heavenly comfort o'er
Three kindred-kingdoms' sons together kneeling.
Oh, may that Church, Episcopal and pure,
One Mother of that kneeling company,
In essence one, in name and office three,
Mid outward storm and darkness still endure:
Be comforted of Christ in God's good time,
And share the sunshine of a heavenlier clime."

Herschel's sonnet in reply (p. 494) was handed to Hamilton the following morning:—

"ON A SCENE IN ELY CATHEDRAL

"The organ's swell was hushed, but soft and low
An echo, more than music, rang; when he,
The doubly-gifted, poured forth whisperingly,
High-wrought and rich, his heart's exuberant flow
Beneath that vast and vaulted canopy.
Plunging anon into the fathomless sea
Of thought, he dived where rarer treasures grow,
Gems of an unsunned warmth and deeper glow.
Oh! born for either sphere! Whose soul can thrill
With all that Poesy has soft or bright,
Or wield the sceptre of the sage at will
(That mighty mace which bursts its way to light).
Soar as thou wilt! or plunge—thy ardent mind
Darts on—but cannot leave our love behind."

We have introduced these verses not so much on account of the poetical merit they possess, which we confess appears to us to be but slight. They may, however, serve as samples of those poetical effusions with which these volumes teem—indeed they give the impression that there must be some occult sympathy between poetry and astronomy. It is well known that Romney Robinson was a poet, and though it does not appear that Sir George Airy had plunged into verse, yet when he and Hamilton were together at Parsonstown there was an amusing contest between the two Royal Astronomers as to which could repeat most English poetry. The present writer has heard this scene described by the late Earl of Rosse, who said that Sir G. Airy was admitted to have carried off the honours.

As an illustration of one of the less important mathematical labours of Hamilton we may mention his paper on the Hodograph, communicated to the Royal Irish Academy in 1846. This elegant conception is a curve whereof the radius vector to any point from the origin represents both in direction and in amount the velocity of a moving particle. Many interesting applications were made by Hamilton, and are referred to in correspondence with Whewell. A somewhat ludicrous incident in connection with the hodograph is recorded (p. 543). It appears that at the same meeting of the Academy in which the hodograph was discussed, Hamilton also exhibited Prof. Mädler's just published work on "The Central Sun." This precarious speculation was by the reporter injudiciously blended with the hodograph, and an astounding statement went the round of the papers asserting that Hamilton's wonderful calculus had succeeded in discovering the central point of the universe!

It is not, perhaps, generally known that the real discoverer of the hodograph was Bradley (see Rigaud's edition of Bradley's Memoirs, Oxford, 1832, p. 283). Bradley has there given a most elegant geometrical investigation of that circle related to elliptic motion which Hamilton afterwards named the hodograph.

The religious side of Hamilton's character demands a few words of notice. He was a member of the Establishment, and many passages show that he had the sympathies of a sound churchman. He seems to have been an admirer of Pusey, with whom he was also personally acquainted. We also find occasional reference to the midnight vigils with which he awaited the new year, and to the fasting which he sometimes practised for devotional reasons. We should imagine, however, that such exercises were but very occasional to a student so laborious yet so irregular as Hamilton.

He found time to be president of a local branch of the Society for the Propagation of the Gospel. He assumed the duties of a churchwarden, and vanquished Archbishop Whateley in a controversy on the orthodoxy of an inscription on the church window at Castleknock. At Whitsuntide we find him writing a dynamical theory of the ascension of our Lord, in which in mediæval fashion he proceeds to evaluate the *duration* of the phenomenon, which he demonstrates to have been less than the interval between Holy Thursday and Whit Sunday.

It is with evident pain that the biographer has felt himself compelled to record the one great failing of his illustrious friend. The excessive devotion of Hamilton to study and the engrossing nature of those mathematical reveries in which he indulged led to the formation of very irregular habits. He "too often found the dawn surprise him as he looked up to snuff his candles after some night of fascinating labour." The necessary hours for rest and refreshment being disregarded, he was led to the dangerous practice of an undue recourse to alcohol, and occasional intemperance was the consequence. Two or three scenes arising from this cause have been described in this volume. There is one which can hardly have been witnessed except by the biographer himself, but which his conscientiousness has compelled him to record. There is a second on a public occasion which caused the deepest grief to Hamilton's friends, one of whom called upon him with a kind remonstrance which was received by Hamilton in a manner worthy of his high character. There is also a third incident, perhaps the most painful of all, which illustrates the attempt of Hamilton to reform and the circumstances under which he relapsed.

We certainly have no intention of citing these passages in this place, for if torn from their setting in the life of this great man they would probably convey an exaggerated notion of the extent of his infirmity. We would rather record the words of Mr. Graves, where he says (p. 335):—

"It is mournful that what seems to have been an inconsiderate, and at first unconsciously indulged, defect in external regimen of life, for such in the inception was his infirmity, should avail to cast a shade over qualities so solid and so splendid as the moral and intellectual qualities of Hamilton."

We have still to look forward to the third and concluding volume of this important work. In it we are to read how Hamilton continued his stupendous labours which culminated in the appearan[illegible] work, the "Elements of Quater[illegible] promised that extensive correspondence with De Morgan, which will secure the attention of every lover of the "Budget of Paradoxes." At the close of our former notice we insisted on the duty which devolved on the University of Dublin of publishing in a collected form the mathematical writings of their illustrious son. This duty has not yet been discharged; let us hope that it will not be left to some foreign mathematician to undertake the work which it should be the glory of Trinity College to complete.

## AN AGRICULTURAL NOTE-BOOK

*An Agricultural Note-Book.* By W. C. Taylor, Aspatria, Carlisle. (London: Longmans, 1885.)

IT is not often that note-books are published, and it is well. Notes are in their nature fragmentary, and disposed towards brevity, often lapsing into crudity. They are a sort of skeleton of imparted knowledge, or at least rather anatomical than living, moving, and breathing information. The least and the most that may be reasonably expected of them is that they should be correct. The small book which has just been published by Messrs. Longmans does not commend itself to our judgment. It is crude, fragmentary, and almost inarticulate or unintelligible. It purports to contain a body of teaching and of facts, but it really consists of disjointed sentences, the meaning of which it is often very difficult to gather. The grammatical construction of the sentences is also fearful and wonderful. To give an idea of this latest contribution to agricultural science, we select the opening passage, page 1, which reads as follows:—"The science of agriculture. Definitions and terms. Its definitions. Scientific truths taught by the practice of agriculture." "The practice of the farm teaching the science. The laws of agricultural science best learnt when thus taught, and lead to improvements in the application of science to farm practice." If this is a definition, much has been written in vain as to the difficulty of defining. It not only fails in definiteness, but is curiously involved, as well as untrue, for "the practice of the farm teaching the science" is an impossible and impracticable idea.

The word "its" before each paragraph of definitions and terms appears to bear reference to the general heading, "The Science of Agriculture," and cannot be supposed to bear a grammatical relation to "definitions and terms." Taking this view of Mr. Taylor's "notes," we read as follows:—

"Its character in the soil, as temper, will, and disposition. These to be noted: success of farmer depending much on his knowledge of above (sister sciences). *Hungry, sick, grateful, obstinate, kindly, tender*, &c."

We defy any one to make any sense out of these utterances, whether taken with or without their context.

Next we have an attempt at further amplification. Thus "1 HUNGRY—constantly in want of food." Now, be it remarked that the subject is *soils*, and we are told that a soil is "hungry, constantly in want of food." Also that it is "sick." Here is indeed confusion of metaphor and blind guiding with a vengeance. Only let readers of NATURE endeavour to picture to their minds a hungry and sick soil! No wonder that Mr. Taylor in the richness of his fancy can further enlarge upon its gratitude, tenderness, and kindliness. Page 1 would itself furnish ample matter for review. It is as full of difficulties as the Moabitish stone, although it might so well repay deciphering.

Again we read: "Short supply of organic matter improved by adding clay, where practicable, and vegetable matter." While concurring with the last simply-given advice as remedying the fault in question, we deny that any amount of clay can help towards this end.

Turning p. 1, we come to p. 2, where we begin at the top as follows:—"3. TENDER.—Hard and baked. Improved by rain, drags and harrows at right time." This tender soil is then hard and baked, and it appears also that it is improved by certain natural and artificial agencies which we thought were not only and solely unfit for the amelioration of such tender, albeit hard and baked soils.

On the same page we are thus enlightened as to the primitive rocks:—"The primitive rocks differ from materials yielded by decay, which is accomplished by oxygen (O) and carbonic acid ($CO_2$), gases invisible and transparent. Both attack rocks and metals, however hard; seen in the mould-board of the plough reducing it (?) to a powder without noise. *Temperature* and *water*, other two *agents* acting on the *Traitor's iron* and *potash*, loosening particles from the hard rock." . . . . These agents are the *friendly helpers* to the farmer. The italics are Mr. Taylor's own. We are irresistibly reminded of Mr. Weg and Mr. Venus, those two "friendly movers" in "Our Mutual Friend."

Passing onwards through the dreary succession of sentences devoid of subject, predicate, or copula, we arrive at p. 12, where instruction is given upon the various component parts of soils. Here we find the following information regarding alumina:—"Alumina. (1) Present in the soil, but not in plant food. (2) Double silicates are (1) silicate of alumina, (2) (*a*) lime, (*b*) potash, (*c*) or of soda, (*d*) or of ammonia. (3) Order of compounds, $H_3N_1K_2CO_3$, $Na_2CO_3$. The higher favourite puts out a lower and unites with the silicate of alumina. (4) The powers of vegetable life command an influence over each and all the second-rank partners. (5) Performs work of outdoor servant. (6) Reconstructs broken-up partnerships. (7) Amidst the faithless, constant only she. (8) Acts as purveyor of food for the plant."

We leave this extraordinary statement of the eight duties of alumina in the soil to the judgment of any sound scientific man or agriculturist, asking only why young people should be subjected to teaching so completely misleading, erroneous, and unintelligible, on the plea that they are obtaining insight into the principles of agricultural science?

## THE PREVENTION OF BLINDNESS

*The Causes and the Prevention of Blindness.* By Dr. Ernst Fuchs, Professor of Ophthalmology in the University of Liége. Translated by Dr. R. E. Dudgeon. 8vo, pp. 230. (London: Baillière, Tindall, and Cox, 1885.)

UNDER the title of "The Causes and Prevention of Blindness," Dr. Dudgeon has translated an essay, written by Dr. Fuchs, of Liége, under the conditions of a competition announced by the "Society for the Prevention of Blindness in London," and to which the prize of 80*l.* offered by the Society was awarded. The book may be described as cont ining a succinct exposition of the chief causes of blindness, and an endeavour to render them intelligible to non-medical readers; the object being to obtain the cooperation of the public in the removal of these causes, in so far as that desirable end may be attained by improved hygiene, and by a better knowledge of the most favourable conditions of ocular work.

The causes of blindness which may fairly be said to be thus remediable, even including under blindness high degrees of defective vision, are two in number—namely, the purulent ophthalmia of new-born infants, and the progressive short-sight which is not uncommon in schools. The former is a disease which might frequently be prevented, which is always curable if treated in good time, but which, if neglected, is almost certain to destroy the sight; and to neglect of its early stages among the poor, and in remote country districts, probably four-fifths of the blindness which occurs among children in this country may be ascribed. Several months ago the Ophthalmological Society of the United Kingdom, moved thereto by Dr. McKeown of Belfast, sent a deputation to the Home Secretary to call the attention of the Government to the dangerous character and the easy curability of this affection, and to urge that steps should be taken, through the instrumentality of the Registrars of Births, to diffuse a more general knowledge of the importance of early treatment. Partly through the opposition of the Registrar-General, the deputation met with no encouragement; and the information given by Dr. Fuchs is therefore as opportune as it is valuable, and might with great advantage be communicated to the poor by clergymen, schoolmasters, and others. It may be said, however, that many of his recommendations apply chiefly to countries in which the employment of midwives is more general than in England.

The progressive short-sight of the educational period is a matter which has lately attracted much notice in all civilised countries, and Dr. Fuchs has nothing to say concerning it which is original. He presents, nevertheless, a brief and convenient summary of the facts, and a good description of the methods of school lighting and fitting which are most to be commended. This part of his volume may be studied with great advantage by any teachers and managers to whom the more systematic treatises upon the subject are either unknown or inaccessible. The book contains one serious error, which, in the English version, has been slightly modified by a mistranslation. Dr. Dudgeon writes, with reference to the provision for instruction about eye diseases in the medical schools of Great Britain and Ireland—"There are eye departments in all the large hospitals, but as a rule no regular lectures on ophthalmology are delivered." The word rendered "ophthalmology" is in the original not "*ophthalmologie*," but "*augenheilkunde*," and the correct translation would be "the treatment of diseases of the eyes." On this subject, that is to say, upon so much of ophthalmology as has any direct bearing upon the duties of the medical practitioner, systematic lectures are delivered in every medical school in the United Kingdom; and it is difficult to believe that the translator could have been unacquainted [illegible] fact. "Ophthalmology," of course, takes a [illegible] range, and embraces branches of optics and [illegible] with which the practitioner, unless a speci[illegible] disease, has neither time nor reason to concern [illegible]

## OUR BOOK SHELF

*Among the Rocks round Glasgow: A Series of [illegible] Sketches and other Papers.* By Dugald Bel[illegible] Edition. (Glasgow: Maclehose, 1885.)

THIS volume furnishes a good example of what [illegible] man can do in his few intervals of leisure. The [illegible] is mainly based on notes of excursions kept by the [illegible] while acting as secretary to the Glasgow Ge[illegible] Society. It affords a fairly accurate idea of the [illegible] cal structure of the country round about Glas[illegible] of the principal features of interest which the ma[illegible] district present. The excursions extend as far as [illegible] take in the course of the Clyde and not a few [illegible] on its banks. Many of the papers are pleasant [illegible] and even geological specialists may find something [illegible] pages to interest and inform.

*Three Martyrs of Science of the Nineteenth C[illegible] Studies from the Lives of Livingstone, [illegible] and Patterson.* By the Author of "Chron[illegible] the Schonberg-Cotta Family." (London: [illegible] 1885.)

THE author of this volume tells the story of these [illegible] remarkable lives very pleasantly and instructive[illegible] however, from the religious than the scientific [illegible] A very fair account is given of the work accomplished [illegible] Livingstone in Africa, though the author does not [illegible] to be quite aware of the value of the geographical [illegible] accomplished by Gordon on the Upper Nile.

## 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. No notice is taken of anonymous communications.*]

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel [illegible]*]

### Upper Wind Currents over the Equator

THE importance of an accurate knowledge of the general circulation of the atmosphere over the equator is so obvious and so little known that the following observations, taken on a voyage from Aden to Australia in February, 1885, may be of interest:—

Over the north-east monsoon, north of the line, the surface wind was east-north-east, while the low clouds came from the east. No high cirrus was ever seen.

In 2° N. lat. the surface wind lower clouds came from N.N.E., the next layer of cirro-stratus from E. rather [illegible] the highest cirri drove very slowly from E.S.E.

In about 1° S. lat. the surface came from N.W. (the N.W. monsoon), small flecks of low cloud from N.E., while [illegible] cirri moved from E., at a moderate rate.

In 5° S. lat. the surface wind still blew from N.W., the lowest cumulus moved from N.N.W., the next layer of [illegible] stratus from N., while a still higher layer of cirrus came [illegible] from E. or E.S.E.

In 10° S. lat. the surface wind came still from N.W., and the clouds at moderate altitude from S.E.

In the "Doldrums," which we only reached in 13° S. lat., the surface wind was from S. and the clouds from S.E.

After we entered the S.E. trade [illegible] S.E., the clouds drove from S., [illegible] trade drew into E.; the clouds ca[illegible]

The relation of upper to surf[illegible] is just what might have been ex[illegible]

systematic
in the United

easterly current over the N.W. monsoon and of an upper current over the S.E. trade, more southerly than the surface wind, is not only altogether new, but also quite anomalous.

In Australia, and the Southern Hemisphere generally, the upper current over a N.W. wind is from about W. and over a S.E. wind from about E.

On my way home I ran a section across the Atlantic from Rio to Teneriffe, but the absence of cirrus prevented any satisfactory determination of the upper winds in that region.

The matter is, however, so important that I start again in a few days for the hurricane region of Mauritius, where I hope to observe one of these exceptional cyclones. Then I hope to repeat a section of the Indian Ocean between Mauritius and Bombay, and afterwards, if all goes well, to get some sections in the Pacific to see what the meaning of this curious discovery may be.

RALPH ABERCROMBY

21, Chapel Street, S.W., October 26

### The Hellgate Explosion and Rackarock

THE statement in NATURE of the 15th inst. (p. 575) that rackarock is "blasting gelatine" or "nitroglycerine with compressed gun-cotton" is incorrect. Rackarock is simply powdered potassium chlorate, impregnated with an inexpensive oily combustible, such as coal-tar oil, and is one of my safety-explosives, which I discovered in 1870, patented in England, April 6 and October 5, 1871, and described more fully in the *Journal* of the Chemical Society for August, 1873, under the title: "On a New Class of Explosives, which are non-Explosive during their Manufacture, Storage, and Transport."

I am not responsible for the quaint name which the Americans have been pleased to give to my child.

As the so-called "rackarock" is not very sensitive or easy to explode, it requires a strong primer or detonator to set it off. This property, which I have fully discussed and particularly accentuated in my paper of 1873, explains why Gen. Newton, the Chief Engineer of the Hellgate mine, took the precaution of placing as a primer such a powerful charge (33 tons) of expensive dynamite on the cheaper charge of the potassium chlorate mixture (107 tons), a precaution carried here perhaps a little too far.

Still it is satisfactory to see that my safety-explosive performed the main part of the labour and rendered good service in the advancement of the works of peace.

H. SPRENGEL

Savile Club, 107, Piccadilly

[We are very pleased to insert Dr. Sprengel's correction as to the composition of "rackarock." Up to the time of our notice about the explosion going to press the only information we could obtain was that it was the same substance as blasting gelatine, but with a less portentous name.—ED.]

### An Earthquake Invention

IN your number for October 15 (p. 573) your numerous scientific readers will be interested to find a pretty long letter under the above heading from so able a seismologist as Prof. John Milne, of Tokio, Japan. Yet, his invitation notwithstanding, I must decline any discussion with *him*, either about my old letters which he refers to, or his own much changed opinion on their subject, since the occasion for my writing them occurred.

Those points, Mr. D. A. Stevenson, who is also invited, may, or may not, take up. My letters were impersonal, and dealt only with a British Association Report. I desire also to continue to keep them strictly to that, even to the very words of the particular Report as given forth to the world with all the usually unquestioned authority of that mighty Association, in their B.A. volume for 1884, p. 248, Section entitled "Experiments on a Building to resist Earthquake Motion."

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, October 16

### [illegible]aviour of Stretched Indiarubber when Heated

[illegible]ATURE, vol. xxv. p. 507) you permitted me [illegible] the invariable success of an often-quoted [illegible]ers of bismuth and iron, intended to [illegible] between specific heat and thermal co[illegible] I have made further progress along

[illegible]ing that if lead is substituted for the bismuth [illegible]ctly, as theoretically it should do.

the evil road of scepticism. I should like, in fact, to ask whether it is absolutely true to say without qualification, as is done in many text-books, that india-rubber (when stretched) forms an exception to the general law that the volume of a body is increased when the temperature is increased. The usual form of the experiment supposed to prove this is well known: a piece of india-rubber tube or cord is stretched by a weight connected with a long light index-lever, and it is shown that when heat is applied the india-rubber gets decidedly shorter.

I have always had some hesitation in showing and explaining the result of the experiment in the above way, especially as I could not find any proof given that the contraction in length was not compensated, or more than compensated, by an expansion in other directions (like that of a worm in its creeping progress, or of a dry rope when wetted). I had, in fact, lately arranged an apparatus for determining the coefficient of expansion of india-rubber, whether positive or negative, when I found that the subject has been very fully investigated by Dr. J. Russner, of Chemnitz (see Carl's *Repertorium* for 1882, pp. 161 and 196).

His results are briefly these:—

(1) That india-rubber (of which several kinds were examined) has without exception a definite coefficient of expansion which is always positive; experiments made at temperatures varying from 0° to 53°·4 gave, for its value at 10°, 0·000657; at 30°, 0·000670.

(2) That india-rubber in a stretched state expands to the same extent as when it is not stretched. No point of minimum density was observed, such as Puschl supposed to exist.

(3) That the apparently anomalous behaviour of stretched india-rubber when heated is simply a case analogous to those of anisotropic crystals, which expand to different extents in different directions. Iceland spar, for instance, as Mitscherlich showed, actually contracts in a direction at right angles to its principal axis when heated, although its volume is, on the whole, increased.

Although ordinary india-rubber is, of course, isotropic, yet when stretched it becomes anisotropic, as may easily be shown by stretching a piece until it is semi-transparent, and placing it between crossed Nicols; the direction of the strain lying at an angle of 45° with the plane of polarisation. Distinct colours, as with a selenite film, will be seen, varying from red to blue with the amount of strain.

The fact that india-rubber becomes hot when stretched, and especially if stretched and allowed to contract several times in succession, may perhaps be accounted for by molecular friction. It would almost seem, then, that in the account given in many books the truth, as well as the india-rubber, has been slightly "stretched."

H. G. MADAN

Eton College, October 23

### The Resting Position of Oysters

IN carrying out a series of experiments on the artificial breeding of oysters in my private aquaria, I noticed that the young oysters born in the tanks rested on the flatter shell when they obtained a flat surface, such as a tile, to adhere to, but when I so arranged that they had irregular surfaces to deal with, such as little bundles of twigs, some adhered one way, and some the other. But where young oysters, nearly two years old, were moved from their original supports, and were compelled to find new ones, they selected the flat shell to rest upon in every instance, except where they were placed on sand, in which case they rested on the convex shell, in order apparently to avoid clogging the mouth of the shell with sand. Is it not possible from these observations that adult oysters vary their position according to the nature of the ground they are on. I have seen adult oysters on muddy ground lying on the convex shell, while where adhesion to a flat surface could be obtained, they were all on the flat shell, and pectens are dredged with Balari and other growths on the flat shell in some instances, and on the convex shell in others, principally, however, on the latter.

H. STUART-WORTLEY

South Kensington Museum, October 23

### The Value of the Testimony to the Aurora-Sound

I HAVE read with much interest the descriptions of this sound as given by Dr. Sophus Tromholt's correspondents in NATURE of September 24. I was, however, struck by the similarity of these descriptions to the well-known phenomena of *tinnitus* *aurium*, and it occurred to me that since a large number of persons have noises in the head—say one-half the entire adult population—it is probable that, when listening intently, a considerable number of observers heard the sounds of their own ears only. This is especially true of "sizzling," "hissing," and "buzzing" sounds.

If physicians affected with tinnitus are not careful to exclude the noises propagated in their own heads, they may discover many curious physical signs in the chests of their patients in making auscultatory examinations. SAMUEL SEXTON

12, West Thirty-fifth Street, New York, October 12

### The Red Spot on Jupiter

ON October 24, at 17h. 32m., this object was estimated exactly central on the planet. As seen with my 10-inch reflector, power 252, the spot was very plain, though the low altitude of Jupiter rendered the telescopic image far from good.

My impression is that this red spot is now decidedly more conspicuous than it was when I last saw it on July 8, and that during the ensuing opposition it will again attract general observation as one of the most prominent features of Jovian detail. This well-known marking has now been watched for more than seven years, and its present aspect leads to the inference that its existence will be indefinitely prolonged. We may therefore justly regard it as a lineament of singular permanency. Though its motion and appearance (*i.e.* tint) have been subject to considerable variation, there has been little, if any change in either the shape or size of the spot. The mystery regarding its origin and real nature may perhaps ultimately be revealed on the basis of renewed and more exact observation in future years. W. F. DENNING

Bristol, October 25

### A Remarkable Sunset

WHILE out for a walk this afternoon I was struck by a peculiarity in the sunset which I do not remember to have seen noticed before. The sun set about 4.43 p.m., and there was the usual "after-glow." I began to notice this first about five o'clock; there was then in the west a large bank of cumulus cloud rather low down, above this was a brilliant lemon-yellow, very bright, and this was bounded by a broad arc of a pale pink, the latter fading away into the light blue of the sky. Very soon afterwards I noticed that the pink arc, instead of being continuous, was really made up of a series of beams of bright light, which pointed to the position of the sun. I counted these, and made out five bright rays at unequal distances apart; behind this (as it seemed) there were a few yellow cirrus clouds. A sunset like this I have often noticed before, but what followed is, I think, novel. The bright rays were slowly turning round like the spokes of a huge wheel moving in a direction contrary to the hands of a watch. I noticed also that the breadth between the bright rays altered, two of them seeming to almost coalesce. In about ten minutes' time one ray turned approximately through 90°, and a new ray brighter than the other appeared on the right. The altitude of a ray when vertical was from 30° to 40°, I should say. By 5.15 the rays became very faint and soon vanished, though above the dark bank of cloud I could detect a faint crimson-lake glow.

The day had been fine on the whole, except that there had been a little rain early in the morning, and a very heavy rain shower between 12.30 and 1 o'clock. The air was extremely clear, and the wind was blowing freshly from the west, or perhaps it was a bit north of west. It was blowing slightly from right to left across the line joining me to the sun.

This phenomenon of the pink rays revolving seems to be explained by the dark spaces being due to clouds which were being hurried along by the strong west wind. I should like to know if any one living in a line W.S.W. of Cambridge noticed broken masses of cumulus clouds this afternoon *westward* between 5.0 and 5.15 p.m. Greenwich time. PAUL A. COBBOLD

Caius College, Cambridge, October 26

### A Tertiary Rainbow

THE supposed tertiary rainbow about which I sent a note a month ago must have been a halo formed by ice crystals, as readers of NATURE will perhaps have inferred merely from the recorded distinctness of the colours. It did not occur to me that ice crystals would be found in a horizontal direction from here, over the hot plains of the Punjab on the evening of an August day. But I have since calculated the size of the tertiary rainbow and the order of colours in it, and the calculation leaves no doubt that the phenomenon must have been a solar halo, caused perhaps by a hailstorm over the plains.

Thandiani, Punjab, Sept. 25 T. C. LEWIS

### The Sense of Colour

IN the early English "Lay of Havelok the Dane" the following words occur:—

> "Also he wolde with hem leyke
> That weren for hunger *grene* and bleike."

Mr. Allan Cunningham in his interesting paper (p. 604) does not allude to this old use of the word green. Is it a solitary case? MARGARET HEATON

Belvedere, October 24

### Stone Axes, Perak

A CURIOUS Malay superstition has come to my knowledge concerning these implements. They appear to be very rare out here, and those found are treasured by Malays as lucky things to have about the house. I have as yet only been able to procure two specimens. One of these I have described in a paper on the Sakaies read before the Anthropological Society in June last. This nearly resembles Fig. 55 in Dr. Evans' "ancient Stone Implements of Great Britain," and is made of a soft description of slate which can be scratched with the thumb-nail. The other is of a much harder description of slate almost like greenstone; it much resembles Fig. 76 of the same work. It is $7\frac{3}{4}$ inches long, $1\frac{3}{4}$ inches wide at the widest end, which is sharpened, and $1\frac{1}{2}$ inches wide at the other end, which is not sharpened. The faces are flatter than those figured by Dr. Evans and the sides perfectly squared. It is beautifully polished, but several depressions are left all over it, showing that it had originally been chipped out. The Malays call them Bâtu-lintarh—*i.e.* thunder-stones—and account for their presence by saying that they are the missiles used by angels and demons in their continual warfare.

But the peculiarity of the superstition is this: the Malays aver that the soft implement which I have described has been made by an angel or a demon and buried in the earth to become hard and fit for use, and support their argument by saying that these objects have been found freshly made of clay and quite soft, buried in the earth, where they have lately been deposited by some angel or demon for a future time of battle. The Malays say that the bâtu-lintath is hard to procure in this state, as it almost invariably drops to pieces. For this reason they do not value it much, and more particularly because it has never inflicted a wound. The hard polished celt which I have just described, however, they value very highly, because they say it has been used in the aerial warfare and has inflicted a wound on one or more of the combatants. They adduce this supposition from the fact of the several depressions left by the chipping out of the implement, and say that these marks were caused by its contact with the body of one of the demon combatants. This last idea is very closely connected with another Malay belief, and most probably took its rise from it. This belief is that if the blade of a kriss or spear is bent or in any way damaged, it has most certainly wounded if not killed a man or some wild animal, and is therefore proportionately of much greater value. A Malay who professes to be a good judge of a kriss will, if asked to appraise the weapon, invariably first glance along the blade to see if it is bent ever so slightly, and if it is he will most certainly add two or three dollars to its value because it has "m'nikam orang" (struck a man). I have very little doubt that if some of the fine limestone caves of this district were thoroughly examined, they would yield a rich harvest of anthropological material. A. HALE

Batu Gaja, Kinta, Perak, September 6

### Photographic Action on Ebonite

AT the back of one of the cases of lecture apparatus facing a north window in this laboratory, there happens to have been standing for six months or more an ebonite plate with a framed glass plate in front of it, the glass having a star-pattern done in little spots of tinfoil all over it. The thickness of the frame, say an eighth of an inch, separated the two plates from each other.

On taking the n out of the case the other day I noticed the pattern on the glass clearly and sharply imprinted on the ebonite; every little circle well marked. Dust had been plentifully deposited on all parts not screened by the tinfoil spots, and the striking clearness of the impression was mainly due to this local absence of dust; but even on wiping off some of the dust the pattern could still be detected, owing to some difference of surface between the exposed and the shaded portions.

It evidently is another illustration of Prof. McLeod's observation of the effect of light on ebonite, the modified surface affording an easy lodgment for dust. In case there be anything more in the matter it is proposed to replace the same or similar plates, and observe at intervals.

EDWARD E. ROBINSON
Lecture Assistant to the Professor of Physics in University College, Liverpool

## THE SLIDE RULE

IT is a perpetual source of amazement to those who are familiar with this instrument that its use is not almost universal. People of every class have to make simple calculations, while those engaged in scientific work, in designing apparatus, or in invention perpetually cover sheets of paper with figures, all of which trouble and the loss of time which it involves might be saved by the intelligent use of a good slide rule, and yet, for reasons difficult to find out, the habitual use of this instrument is limited to a very small proportion of the calculating community.

Most people know that the scales are logarithmically divided—that is, that the distance between the divisions marked 1 and 10 being in imagination divided into 10,000 parts, the division marked 2 is at the 3010th of these parts, the division marked 3 is at the 4771st of these parts, and so on, 3010 being the log. of 2, 4771 the log. of 3, and so on; and further, that the spaces between these whole numbers are similarly divided into fractional parts, thus 1·1 is at the 414th of the imaginary parts and 1·01 at the 43rd of these parts, 414 and 13 being the logs. of 1·1 and 1·01. This is very generally known, but it is more generally believed that to use the rule involves so much thought and anxiety that it is far simpler to work out results in the usual way, or at any rate that the rule can only be of any real assistance when a great number of similar calculations have to be made; and further that, as the results to be obtained are not absolutely correct, that as an extreme error of 1, 1-10th, or 1-100th per cent. is possible, according to the nature of the instrument, it is not really to be trusted. These objections are easily answered. As soon as the slight difficulty of reading the rule has been overcome—a difficulty due to the fact that in ascending the scale the divisions become closer, so that if there is room for ten subdivisions between 10 and 11, there are only five between 20 and 21, and two between 40 and 41—a difficulty which once overcome never recurs—then the simpler calculations, such as multiplication, division, and simple proportion, can at all times without an effort or a thought be instantly performed, while those involving proportions in which some of the terms are squares, cubes, roots, sines, or tangents can, after a moment's reflection, be as easily completed, so that even in the case of single operations time is saved. It is true when many calculations of the same kind present themselves, especially if some of the terms in the series are identical, that the use of the rule is specially advantageous; but in any case mental labour and time are saved.

As to the probable accuracy of results obtained by the use of the rule, they are in general superior to the accuracy with which the figures which require reduction have been determined, or, if this is not the case, they are in general so nearly correct that the error is of no consequence. For instance, if the marks obtained by several examinees are to be reduced to correspond to a total of 100, the commonest rule, which gives an accuracy of 1-300th part, is sufficiently good; for the nearest whole number only, and the right order are all that are needed. It would be absurd to doubt the accuracy of the instrument because it cannot be trusted to give figures correct to one part in a thousand. Or, again, if the weight of a piece of metal has to be determined from its dimensions, a good rule trustworthy to 1 part in 1000 will in almost every case be more than good enough; for, even if the specific gravity of the material be known so truly, it is not often that the piece can be made so near the specified size that the discrepancy which may ultimately be observed will be due more to the error of the rule than to the inaccuracy of construction. In such a case it would be as absurd to discard the rule as untrustworthy as it is to use 7-figure logarithms for the calculations of an ordinary chemical analysis. There are cases, of course, where observations can be made with a degree of accuracy beyond that which is obtainable by any rule—for instance, determinations of mass, length, angles, and time can all be made with extraordinary precision. Where, then, uncertainty is not introduced by observations of another kind, where the entire precision to be obtained in any such observations may be expected in the result, as, for instance, in the determination of the refractive index of the glass of a prism, in such cases the slide rule is unsuitable, and tables of logarithms furnish the most obvious means of making the calculations. Or, again, when pounds, shillings, and pence are involved, a result correct to the nearest farthing is generally desired to make accounts come right, and so, unless the sums dealt with are moderate, the slide rule is again unsuitable. However, the calculation of interest furnishes a good example of proper and improper use of the rule in making calculations. If it is required to find what a certain sum ($s$) will be worth at the end of a year at so much ($r$) per cent., the result might be found from the proportion $100 : 100 + r :: s : x$. Here the amount $x$ would be determined with an accuracy of say 1-1000th part, so that if 1000*l*. were involved, an error of 1*l*. might arise. This is an improper use of the rule. A greater degree of accuracy would be obtained by the proportion $100 : r :: s$ : the increase of $s$. Here the interest is found to the same proportionate accuracy, and so in such a case the greatest possible error could only be one shilling, if the rate is 5 per cent. This example, though obvious, is given because it corresponds exactly with cases that arise in the laboratory, where the rule, if used properly, is of service, but, if improperly, is useless.

Calculations involving only the simple arithmetical rules, when extreme accuracy is required, are best performed by the help of a table of logarithms, or with an arithmometer; in fact with an arithmometer a far greater degree of accuracy can be reached than with ordinary 7-figure logarithms, and though they are also suitable for calculations in which only three or four significant figures are required, their great size and expense compare unfavourably with the portability and cheapness of the rule, and, moreover, trigonometrical and logarithmic functions cannot be found with them. These machines are shown at the Inventions Exhibition by Tate and Edmonson, and are worth examining. There is another calculating machine close to Tate's, by which the interest on any sum at any rate per cent. for any time may be found to the nearest halfpenny in an incredibly short space of time, worthy of the attention of those who have to calculate interest. But, to return to the slide-rule, it is astonishing that an instrument like Gravet's, 10 inches long only, with which all calculations, arithmetical, trigonometrical, and logarithmic, can be worked out so easily and with an accuracy of from 1-500 to 1-1000, according to the nature of the calculation, should be so little used.

This is not the place to give instructions for using the rule, but an outline of the method is necessary to make it possible to compare the different makes, many of which are shown at the Inventions Exhibition.

With two similar scales of equal parts, as inches divided into tenths or centimetres divided into millimetres, it is possible to add numbers, or, conversely, to subtract numbers; thus, if the zero of one scale is placed opposite, say, 6·5 of the other, opposite every number $n$ on the first will be found $n + 6·5$ on the second, and so addition or subtraction could be performed, but there would be no advantage in so adding or subtracting. In the same way the slide of the ordinary slide rule is employed to add distances, but these distances do not correspond to the figures attached, but to the logarithms of those figures, and so the sum which is found by such an addition is not the sum of the figures apparently added, but their product. If the slide is placed at random, all the pairs of figures which are opposite to one another are in the same proportion, and the multipliers which will change either series into the other will be found on each scale opposite the divisions marked 1 on the other. It requires no great amount of memory to bear this in mind: however the slide may be set, those numbers which are opposite to one another are in the same proportion, *i.e.* have a common quotient, which may be found opposite any of the divisions marked 1; and yet this is all that has to be remembered in multiplication, division, and simple proportion. The two top lines of a slide rule are generally identical, and they are used for these simple operations; they are generally distinguished by the letters A and B. In general the bottom line of the slide, that is, the third altogether, is identical with the first two, and is labelled C. This arrangement is convenient, for it is possible to insert the slide upside down, in which case all numbers which are opposite one another on A and C have a common product, which may be found opposite any of the divisions marked 1. This furnishes the most ready mode of finding actual or approximate factors of numbers, and is of great use to those who have to calculate wheelwork; further, by the use of the inverted C line under the A line any harmonical progression can at once be read, and any number of harmonic means can be inserted between two quantities. The fourth line is generally made different from the others in that it is on double the scale, and it is then distinguished by the letter D. If the units of the C and D line are placed opposite one another, a table of squares and roots is formed, or if in any other position the squares of the numbers on D vary in the same proportion as do the numbers that are opposite to them on C. It is in calculations made on the C and D lines that so much time is saved, for proportions in which some of the terms are squares or square roots can be worked out as quickly and as accurately as those in which simple numbers only are employed. If the slide is inverted so as to bring the B line opposite to the D line, then the square of any number on D × the number opposite to it on B is constant. This product may of course be found in B opposite 1 in D. Cube roots, among other things, may be found in this way.

These four lines are all that are generally found in a slide rule; occasionally others are added: thus a line on one third of the scale of the D line (sometimes called an E line) will, with the D line, enable one to directly work proportions in which some of the terms are cubes or cube roots, but this is not often required. With the usual four lines all arithmetical processes, except addition and subtraction, can be performed. There are, however, rules in which on the back of the slide are scales in which the distances are log. sines or log. tangents of the angles marked, then these lines being placed against an ordinary A line so that 90° on the line of sines or 45° on the line of tangents is opposite 1 on the A line, a table of sines or tangents will be formed; and if the slide is placed in any other position, the sines or tangents of the angles denoted by any divisions on either of these special lines will vary in the same proportion as do the numbers which are opposite them on the A line. In those rules in which lines of sines and tangents are given there is generally a scale of equal parts in which the length of the D line is divided into 500 or 1000 parts. If this is placed opposite the D line, with the ends of the two scales opposite one another, a table of logarithms will be seen; thus the logarithm of any number on the D line will be found opposite to it on the scale of equal parts.

Having pointed out the chief uses of a slide rule, it will be possible to describe the differences in construction in the several varieties. The most simple possible form is the original Gunter's scale to be found on any sector. With this and a pair of dividers calculations may be made, for if the dividors are set to the distance between any two numbers, any other pair of numbers which are found by the dividors to be the same distance apart will be in the same proportion, or have a common quotient, just as a common difference would be found if a scale of equal parts were used. This, however, is troublesome; but if the same principle is applied to a scale in the circular form the result is much more convenient. In this case angular distance takes the place of linear distance, and a pair of arms which can be opened to any angle can be moved round, and every pair of numbers covered will bear to one another a constant proportion depending on the extent of the angle. This is the principle of some of Dixon's rules shown at the Inventions Exhibition, near the arithmometers. In the well-known pocket instrument, the calculating circle of Boucher, an instrument like a watch, one hand is fixed and one is movable, and the face is also movable. There is another instrument of the same kind, in which the scale is drawn on a helical line. Here the scale and one hand are movable, and there is one fixed hand. This, which is Prof. Fuller's spiral rule, is made and exhibited by Stanley. Circular instruments are also made, in which scales slide over one another, which are in this respect like the straight rules. There is more advantage in the circular form than appears at first. In the straight rules the A and B lines are each double, the first and second halves are identical; this repetition of the scale is required in order that, however the slide may be placed, the part of each opposite to the other may contain at least a complete scale of numbers. In the circular form, however, the beginning and end of a single logarithmic scale meet, and so the scale itself is its own repetition both above and below. For this reason the openness of the divisors in a circular instrument is the same as in a straight rule, of which the length is six times, instead of three times, the diameter of the circular line.

Of the two types of instrument—one in which one slide works against another, generally straight, sometimes circular, and the other in which there is no slide but only a line divided logarithmically with a pair of hands, which type is always circular—which may be called respectively the slide and the index types, each has certain advantages. The slide form is preferable, in that each setting of the slide furnishes a complete table of pairs of related numbers, as, for instance, of any English and foreign measure, of squares and roots on any scale, such as diameters and areas of circles, or of sines or tangents on any scale, so that, without moving the slide, any number of results may be read off, whereas with instruments of the index type the scale must be moved under the hands, or the hands over the scale, for each result. On the other hand, index instruments are more convenient than the usual slide rules in working out long expressions of the form $\frac{a \times b \times c \times d}{e \times f \times g}$, in which any of the terms may be squares, cubes, sines, or tangents, fo[illegible] terms are taken alternately from the numerator [illegible] nominator and set in order with the fixed and movable hand until all are worked off, when the answer is found under the fixed hand. There is no necessity to observe any result till the process is complete; on the other hand, with slide instruments, each result of the form $\frac{a \times b}{e}$, $\frac{a \times b \times c}{e \times f}$, &c., must be read and set before it can be operated upon by the next pair of factors. In Gravet's rules, however, this disadvantage of the straight form is removed by the addition of a cursor or sliding index, which in other ways is a great comfort.

All instruments of the index type suffer terribly from parallax, owing to the hands being above the face, so that they do not in practice give the accuracy that from the length of scale upon them might be expected.

This is especially the case in small instruments: for instance, Boucher's calculating circle, made in the form of a watch, is probably divided so accurately that on that score an error of one part in a thousand does not exist; yet, owing to parallax, the practical limit is about 1-300. This instrument has, besides the ordinary line, one on a double and one on a treble scale for squares and cubes, a line of sines, and another of equal parts for logarithms.

The possible accuracy of any instrument depends upon the length of the scale included between 1 and 10, called the radius, and also upon the linear accuracy with which a setting or reading can be made; this is at least twice as great in slide as in index instruments. In order to obtain great accuracy various means have been adopted whereby a great length of scale is brought within a small compass. Among slide instruments are Prof. Everett's "Universal Proportion Table," published by Longmans, Green, and Co., and General Hannyngton's slide rule, made and exhibited at the Inventions Exhibition by Aston and Mauder. In these the slide is made in the gridiron form. In Everett's instrument there are twenty bars, the total length of which is about 13 feet; a scale of equal parts is also printed, so that logarithms can be read with it. In both of these instruments only simple proportions can be effected, unless special grids, divided on a double scale or trigonometrically, are provided. Far the most ingenious of all devices for obtaining a great length of radius in a comparatively short space is due to Mr. Beauchamp Tower, whose name is well known in connection with the spherical engine. His instrument is a slide instrument consisting of two tapes running side by side over equal and independent rollers, but the tapes have a half twist in them, so that they have each only one surface and one edge. In this instrument, made privately for his own use, each tape is about 12½ feet long, and as both sides of the tape are used the radius is about 25 feet, and therefore, as far as openness of scale is concerned, it is equivalent to a straight rule 50 feet long, while the instrument itself is only just over 6 feet in length.

Slide rules of the index class can have a great length of scale more readily employed than others. Thus Prof. Fuller's helical instrument has its radius equal to 42½ feet, and is in openness of scale equivalent to a straight rule 85 feet long, while the box which contains it is only $17 \times 3\frac{3}{4} \times 3\frac{3}{4}$ inches inside measure. Dixon exhibits a special rule with the scale extending over 10 concentric circles, but with this form a less degree of accuracy is attainable when using the inner than when using the outer circle. Thus the inner circle is equivalent to a straight rule 30 feet long and the outer to one 60 feet long. There is an outer circle equally and logarithmically divided to find logarithms. In another of Dixon's instruments, similar in size and form, there is the same outer circle for proportion and logarithms, and a series of inner circles divided [illegible] cosines, tangents, cotangents, secants, and cosecants. Each of these is on a board 14 inches square. Rules with very extended scales do not in practice give results with an accuracy which is proportional to their length, though the working accuracy is very much increased. They have this advantage, that they can be worked to their limit with ease, while with a well-divided pocket rule the errors of construction are beyond the limits of vision, and so the calculator is apt to strain his eyes to get results as accurate as possible. For instance, results obtained by a good pocket-rule one foot long can be trusted to a thousandth part; at the same rate Prof. Everett's should be accurate to a thirteen-thousandth part, and Prof. Fuller's to an eighty-five thousandth part. In practice a four and a ten-thousandth part are their limits. Again, instruments with very extended scales have only room for one line, so that simple proportions only and logarithms are all that can be directly obtained from them. For general use in the laboratory or elsewhere where calculations of every kind have to be made, the straight form, on the whole, seems most convenient, because of its portability, the quickness with which it can be worked, the diversity of operations that it will directly accomplish, and the extraordinary accuracy in comparison with other forms of the results to be obtained. Far the best instruments of this type that the writer has yet seen are those made by Tavernier-Gravet, of Paris, already alluded to. They are different to those generally used in England in that the line in the slide which works against the D line is itself a D line, so that squared proportions have to be performed by the aid of the cursor. This form has the further disadvantage that the inverted slide cannot be used for finding factors, which is a great loss; on the other hand, the two lower lines may be used for simple proportions, and they will give a double accuracy. On the whole, the original pattern with an A, B, C and D line seems preferable. Of the straight rules shown at the Inventions Exhibition those made by Stanley exceed all the others in workmanship and they are equal in this respect to the Gravet rule. Among them are rules for special purposes, as Hudson's scales and Ganga Ram's rules. Hudson's scales, which are made in card, each having two slides, are a marvel of constructive skill. Dixon shows his "triple radius double slide rule," with which very complex operations may be readily performed. Heath shows a slide rule for converting sidereal to mean solar time, or the reverse, correct to about ·02 of a second, but this is not a slide rule proper, as the scales are not logarithmic.

There is entirely a different class of slide rule shown by Lieut. Thomson. In this there is, as usual, an A, B, and C line, but instead of the D line there is a "P" line, in which the distances, instead of being logarithmic, are logarithms of logarithms. By this instrument fractional powers may be found as readily as simple products or quotients. It has, however, this defect, that the scale converges so rapidly as the numbers ascend that high numbers can only be obtained with a proportionate accuracy far less than is possible with low numbers. It is one feature in the slide rule of ordinary construction that an error of reading of, say, 1-100th of an inch will produce the same proportionate error in any part of the scale. This rule for involution is shown in the straight and circular form. It is right to mention that the same thing exactly was invented by the late Dr. Roget and published by him in the *Phil. Trans* of 1815.

No attempt has been made to give an account of every special form of rule that is made; those shown at the Exhibition and some other well-known forms, which well illustrate the different kinds of development, have been imperfectly described and the general principles on which all depend sufficiently explained to make evident the advantages of each type of instrument.

C. V. Boys

## HOMING FACULTY OF HYMENOPTERA

IN connection with Sir John Lubbock's paper at the British Association, in which this subject is treated, it is perhaps worth while to describe some experiments which I made last year. The question to be answered is whether bees find their way home merely by their knowledge of landmarks or by means of some mysterious faculty usually termed a sense of direction. The ordinary impression appears to have been that they do so in virtue of some such sense, and are therefore independent of any special knowledge of the district in which they may be suddenly liberated; and, as Sir John Lubbock observes, this impression was corroborated by the experiments of M. Fabre. The conclusions drawn from these experiments, however, appeared to me, as they appeared to Sir John, unwarranted by the facts; and therefore, like him, I repeated them with certain variations. In the result I satisfied myself that the bees depend entirely upon their special knowledge of district or land-marks, and it is because my experiments thus fully corroborate those which were made by Sir John that it now occurs to me to publish them.

The house where I conducted the observations is situated several hundred yards from the coast, with flower gardens on each side and lawns between the house and the sea. Therefore bees starting from the house would find their honey on either side of it, while the lawns in front would be rarely or never visited—being themselves barren of honey and leading only to the sea. Such being the geographical conditions, I placed a hive of bees in one of the front rooms on the basement of the house. When the bees became thoroughly well acquainted with their new quarters by flying in and out of the open window for a fortnight, I began the experiments. The *modus operandi* consisted in closing the window after dark when all the bees were in their hive, and also slipping a glass shutter in front of the hive door, so that all the bees were doubly imprisoned. Next morning I slightly raised the glass shutter, thus enabling any desired number of bees to escape. When the desired number had escaped, the glass shutter was again closed, and all the liberated bees were caught as they buzzed about the inside of the shut window. These bees were then counted into a box, the window of the room opened, and a card well smeared over with birdlime placed upon the threshold of the bee-hive, or just in front of the closed glass shutter. The object of all these arrangements was to obviate the necessity of marking the bees, and so to enable me not merely to experiment with ease upon any number of individuals that I might desire, but also to feel confident that no one individual could return to the hive unnoticed. For whenever a bee returned it was certain to become entangled in the bird-lime, and whenever I found a bee so entangled, I was certain that it was one which I had taken from the hive, as there were no other hives in the neighbourhood.

Such being the method, I began by taking a score of bees in the box out to sea, where there could be no landmarks to guide the insects home. Had any of these insects returned, I should next have taken another score out to sea (after an interval of several days, so as to be sure that the first lot had become permanently lost), and then, before liberating them, have rotated the box in a sling for a considerable time, in order to see whether this would have confused their sense of direction. But, as none of the bees returned after the first experiment, it was clearly needless to proceed to the second. Accordingly I liberated the next lot of bees on the sea-shore, and, as none of these returned, I liberated another lot on the lawn between the shore and the house. I was somewhat surprised to find that neither did any of these return, although the distance from the lawn to the hive was not above 200 yards. Lastly, I liberated bees in different parts of the flower garden, and these I always found stuck upon the bird-lime within a few minutes of their liberation. Indeed, they often arrived before I had had time to run from the place where I had liberated them to the hive. Now, as the garden was a large one, many of these bees had to fly a greater distance, in order to reach the hive, than was the case with their lost sisters upon the lawn, and therefore I could have no doubt that their uniform success in finding their way home so immediately was due to their special knowledge of the flower garden, and not to any general sense of direction.

I may add that, while in Germany a few weeks ago, I tried on several species of ant the same experiments as Sir John Lubbock describes in his paper as having been tried by him upon English species, and here also I obtained identical results: in all cases the ants were hopelessly lost if liberated more than a moderate distance from their nest. GEORGE J. ROMANES

## THE HEIGHTS OF CLOUDS

FROM the Upsala Observatory comes an account of fairly exact measurements of the heights of clouds during the summer of last year, and a very interesting publication it is. It appears that when the circumpolar expeditions were planned the Swedish Meteorological Observatory furnished their station at Spitzbergen with three theodolites, of a somewhat novel though simple construction, for the double purpose of observing the altitude of the aurora and that of clouds. The difficulty that has always been felt in such observations has been that of easy intercommunication between the different observers, so as to fix on the particular part of the cloud of which the height was to be measured. Thanks to modern invention this difficulty was got over by connecting each station with a telephone. The reported good results obtained at the circumpolar station—the publication of which, by the by, has not been done as yet—induced Herr Hildebrandsson, the director of the meteorological observatory at Upsala, to commence a set of similar observations there. On a couple of pillars, about 450 yards apart, and placed on an approximately north and south line, a couple of theodolites were erected, the stations being connected by telephones. The theodolites employed may be described as ordinary theodolites, the object glass of the telescope being replaced by a large open ring, across which were stretched a couple of cross wires, whilst the eye-piece consisted of a simple hole of 3mm. in diameter. When observing near the sun dark glasses would be placed in front of this orifice. As might be expected, there are several unavoidable errors in using these instruments, the principal of which are the uncertainty of an identical point in a cloud being measured at each station, and the want of synchronism of the observation—a very important point when clouds are travelling with any speed. The method of observation was somewhat laborious, and was as follows. The two observers, each at a theodolite, agreed as well as they could on the point in the cloud to be observed, and at a particular time, fixed upon in advance, brought the cross wires on this somewhat indefinite spot, and then read their instruments, noted the time of observation, described the cloud, and if possible sketched it. A second observation of the same point gave the direction and rate of motion of the cloud. Perhaps one of the most easily observed clouds is the cumulus, and we find from a table given that the probable error of ob[illegible] is very considerable. Thus, in one whos[illegible] calculated to be 1,[illegible] metres, the probal[illegible] metres, and of th[illegible] of 101 observation[illegible] 1,6[illegible], and [illegible] metres. The labour to attain even such accuracy is very great. The surprise is that at Upsala they did not adopt a photographic theodolite such as is now, we believe, in daily use at Kew. In the Kew "nephographs," as they are called, the telescope is replaced by a camera, and the observations do not involve half the labour of eye-observations. For instance, when the two nephographs are in a fixed position the manipulations are simplicity itself. One observer telephones to the other the cloud whose height it is desired to ascertain. By means of a very simple pointer both direct their cameras to the cloud, having inserted a dry plate in position. The lenses are closed by shutters, both of which can be opened and then closed with any desired rapidity by an electrical arrangement from one station. The exposures are thus made simultaneously, and the photograph must include every point in the cloud. The position of the cloud is fixed by crossed lines etched on a glass plate which is in contact with the dry plate, and which always occupies the same position, and from these cross lines, which are impressed on the two negatives, any desired point is measured. The readings of the graduated circles of the nephoscope having been taken the height and distance of the cloud is readily calculated. It might be supposed that considerable errors might be made even with this arrangement as the solid angular distance included is somewhere about 55°, and the objects within this are impressed on a plate less than six inches square. As a matter of fact, such is not the case. Measurements of objects a couple of miles off, and at known distances from the observer, have been observed with an error of less than 1 per cent., a base of 250 yards having been used—an accuracy which is far greater than could be obtained by eye-observations when the object to be observed is uncertain in outline, and when there is no definitely fixed point to observe. It must not, however, be supposed that there are no difficulties in photographing clouds of every description. It requires, for instance, a keen judgment to hit off the exposure necessary to differentiate between the white clouds in the higher regions the pale blue sky against which they are projected. All such difficulties are to be overcome with practice. It is to be hoped that before long the Upsala Observatory will adopt such a plan as we have indicated, when the results they obtain will be even more valuable and be less laboriously attained than they are at present.

The following table gives the height of the different characters of clouds at Upsala :—

| | | |
|---|---|---|
| Stratus | | 625 metres. |
| Nimbus (lower) | | 1,115 „ |
| „ higher | | 2,185 „ |
| Cumulus and cumulo-stratus | top | 1,690 |
| | base | 1,307 |
| | mean | 1,498 |
| Lower alto-cumulus | | 1,988 |
| Higher „ „ | | 4,242 |
| Cirro-cumulus | | 5,513 |
| Cirrus | | 6,823 |

The authors point out that, according to their observations, apparently there are seven levels, each one occupied by a different species of cloud, viz. : 600, 1,100, 1,500, 2,000, 42-4,600, 58-6,600, and 80-8,600 metres ; and these levels agree with those deduced by M. Vettin of Berlin, who deduced them from a different mode of observation. There are several remarkable tables, some of which give the diurnal variation in the height of clouds, others the diurnal variation of the frequency of high clouds at Upsala during the summer, others again which discuss the question of the effect of the height of the barometer on the cloud masses. One of the most interesting sections of the [illegible] is that on the calculation of the velocity of wind [illegible] heights from the movements of clouds.

[illegible] the Observatory at Upsala is to be con[illegible] has taken in making systematic observations of cloud heights and velocities. It is a matter of capital importance to meteorology that such should be undertaken in various localities, not only at or near the sea level, but also at as high altitudes as possible. Were the cloud levels, for instance, the same at all places, mountainous districts would be very much more cloud bound than we know is the case. Observations of clouds in the Alps show that the levels at which the different classes are to be found exceed the heights which are shown in the table above ; and it remains to ascertain not only the effect of barometic pressure on the levels, but also the disturbing effect caused by the elevations in the land. Such observations might well be added to the observatory at Ben Nevis, and no doubt some enthusiastic meteorologist would be willing to spend a summer in the Alps to make observations at a still higher station. Until work such as this is undertaken the subject can only be partially discussed on scientific grounds.

W. DE W. A.

## *THE RECENT TOTAL ECLIPSE OF THE SUN*

WE have received the following communications :—

THE news that bad weather seriously interfered with the work of the Government Survey parties, sent to observe the eclipse of the 9th inst. from points on the centre line of totality, induces me to send you the accompanying incomplete sketch and hasty account by to-day's mail :—

I observed the eclipse from Tahoraite, the present southern terminus of the Napier-Wellington Railway, a point well within the belt of totality, but some forty miles north of the centre line.

I went, determined to concentrate my whole attention on the corona, and the corona alone—I did not even take my watch. My eclipse observations are therefore necessarily very incomplete.

After a stormy night (alternate showers of rain and hail, with a bitterly cold wind), day-dawn brought a clear sky ; but a heavy bank of clouds far away to the south boded no good to observers in that direction. The cold was bitter, and fresh snow lay very low down on the neighbouring hills.

The first contact occurred not long after sunrise, the atmosphere in the east being rather hazy, and the light *pale* (other observers say *ruddy*). At first the temperature of the air seemed to rise steadily, but when the sun's disk was a quarter obscured, it began to fall again, and as totality approached the cold became severe.

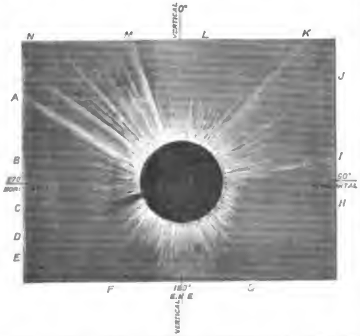
When the occultation of the sun had reached three-quarters, the so-called "livid" character of the light became very marked, and about ten minutes before totality a curious and tremulous play of light on the ground—like dark ripples or moving "marblings," if I may use the word, became apparent.

In order to keep my eyes as sensitive as possible to the faint light of the corona when it should become visible, I only watched the sun (through a telescope) for a few minutes after first contact, I then averted my gaze, and fixed it persistently on the dark-green bush surrounding the Tahoraite clearing. All I noticed during my hasty survey of the disk was two small and one large spot, the latter close to the limb at about 90° (see sketch), and surrounded by faculæ.

The moment "totality" occurred I turned my gaze towards the sun, and having previously, to save time, drawn disks on several pages of my pocket-book, I hurriedly took sketch after sketch of the shape of the corona, the rays of which were much better marked than I had been led to expect. My object in taking several sketches was to record any change in the position of the rays. I took five during the short time of totality, and their agreement is so clear as regards the number and relative position and length of the main rays, that it fully confirms the general impression left on my mind as to the fixity of this phenomenon.

I was just engaged in making a last estimate of the extent of the corona between 35° and 90°, when a cry arose from the bystanders, "Look at the red flame shooting out to the left!" I withstood the temptation, and observed the almost sudden disappearance of the corona on the reappearance of the sun. All I can therefore say of the red protuberance which attracted so much notice is that the emergence of the sun is blended in my mind with a vague and fleeting impression of a narrow streak of red light with a broad streak of white light outside it, between 200° and 290°, and almost symmetrically divided by the position of the dark rift in the corona.

An acquaintance who noticed the rift in the corona told me that the red flame shot out close to it. He described the shape of the flame as *ragged;* other intelligent observers compared it to a *sugarloaf;* the most intelligent




Corona as observed during solar eclipse of September 9, 1885, as seen from Tahoraite, North Island, New Zealand, about 40 miles north of centre line of totality:—A, 300°; longest ray, 2·3 diams. B, first contact about 285° (vague). C, Sun apparently reappears about 260° (vague). D, 250°; dark rift in corona. E, approximate position of large red protuberance which shot out just before close of totality. F, corona, ½ diam., rather ragged. G, corona, ½ diam., regular. H, large sun-spot with faculæ close to the limb at time of first contact. I, 80°; 3rd longest ray, 1½ diam. J, between these two long rays corona extends nearly ½ diam., with some longer rays. K, longest ray, 1¼ diam. L, corona, hardly ½ diam. M, 2nd longest ray, 1½-2 diams. N, between longest rays corona extends ½ to 1 diam.; 2 long rays 1¼ diam. (N.B.—Corona alone was observed: relative position and lengths of rays reliable; absolute lengths to be taken with caution.

of those I heard, to a *drop of water* hanging from an object. Other observers, again, stationed two miles off, saw, *not a red* but a brilliant *white* flame shoot out.

I leave these discordant statements and comparisons to be reconciled by other men.

During totality there was a considerable amount of diffused light around the sun. I am unable to state its extent or colour from personal estimate. Some of the bystanders called the colour pearl-grey; others, reddish; others, again, pale blue and white.

The colour of the corona itself seemed to me very pale bluish green.

The sketch I send you should explain itself. I will only mention that the angles are, of course, only estimated, the zero direction being the upper end of the vertical through the centre of disk.

The rift in the corona was very marked, and extended right down to the disk; it was very near to by far the longest of the rays. In conclusion there is nothing that the coronal rays remind me of so much as an auroral display. N. A. GRAYDON

Hastings, Hawkesbay, N.Z., September 11

Mr. Henry Bedford, of All Hallow's College, Dublin, sends us a copy of the *Marlborough Express*, New Zealand, of Wednesday, September 9, 1885, giving an account of the eclipse as observed at Blenheim and other places in New Zealand.

The eclipse at Blenheim began at 6.30 a.m., and totality occurred at 7.25.

"The totality—if totality it was—could have lasted but a bare moment: for, to the untrained observer, it seemed that a patch of bright sunlight on the upper edge of it was never absent. It must, however, be remembered that Blenheim is on the very outer edge of the belt, and that the apparent duration of totality was so extremely short that, by an optical illusion, it might seem that sunlight was never totally obscured. The corona and sun's flames were plainly visible, and formed a spectacle which no mechanical contrivance can imitate, and no art can reproduce. Several stars in different quarters of the heavens—and particularly one about four sun's diameters below the eclipse—were seen, and the general appearance of the sky and of the shadows on the hill sides and in the water was that of early dawn. The eclipse was certainly a wonderful phenomenon, and almost as interesting to the non-scientific observer as to the man of science who viewed it in his observatory.

"Observations of the eclipse were taken in the cricket ground at Blenheim by Mr. Dobson, C.E., and ten instantaneous photographs were secured by Mr. W. H. Macey, the two gentlemen acting in conjunction. Mr. Dobson's observations were made by the telescope and theodolite, the powerful telescope belonging to Mr. Cullen of Mahikipawa having been erected in the cricket ground for the purpose."

At Wellington, by the time the total phase was reached the sun was sufficiently clear of clouds to give an uninterrupted view. As totality was reached the scene was most impressive, and as the darkness increased the western heavens became illuminated with a deep orange colour, shading off into the most delicate of yellows. A number of stars were plainly seen during the darkness. After about a minute and a half the sun again shone out, and gradually increased. Pigeons and birds began to fly about in a helpless fashion, and sought their roosts.

Dr. Hector reports:—"Heavy southerly squalls, with hail, spoiled the observations. We were at Dryertown, on the centre of the line, but got only partial glimpses. A pink patch surrounded the sun, and extended 15° from it, probably due to the same dust film in a high atmosphere that caused the sun-glows last year."

At Mastertton a heavy south-west gale with rain set in on the 8th, and the morning broke without any signs of clearing. Messrs. M'Kerrow and party, who had camped at the foot of Otahuao, proceeded to the top and fixed their instruments amid driving snow and hail. Just before totality the sky cleared, and all the phenomena were fairly visible. One photograph was taken before totality, three during, and one after. The corona was visible for fully a minute, encircling a ring of light radiating to a distance of about half a diameter of the sun. It was of a pale white colour, like the electric light; of uniform width, except at the sun's equator, where it slightly protruded, and was evidently of greater extent.

We have just received, by the dilatory method of a letter by post, an account of the preparations making and made for the due observation of the Total Solar Eclipse in September, up to within a fortnight of the event coming off; but no more. Our informant, the Venerable the Archdeacon Stock, of Wellington, New Zealand, was momentarily expecting two large auxiliary expeditions, one from Sydney, the other from Melbourne; and had been himself told off for corona work. But though brimming full of fine enthusiasm to do all that man could do in that department, he yet characteristically adds, "but how can we expect to see any of the more refined and minute features through all this Krakatão haze which the sun has still to shine through? In 1882, before that great volcanic eruption, we could see the comet of that year close up to the sun's limb; but now I am certain that nothing of the kind could be visible." C. P. S.

15, Royal Terrace, Edinburgh, October 21

## *NOTES*

Prof. Pasteur read on Monday evening to the Paris Academy of Sciences a statement, of which the following is the substance as telegraphed to the *Standard*:—M. Pasteur some time ago succeeded in rendering proof against rabies some sixteen out of every twenty dogs experimented upon. But to ascertain that immunity had really been given, he had to wait four months after the inoculation had taken effect. He therefore set himself to obtain virus of different degrees of strength, with the object of obtaining prompter and more certain results. This was effected by the following means:—A rabbit was inoculated with a fragment of tissue taken from the spine of a rabid dog. The incubation of the poison occupied fifteen days. As soon as the rabbit was dead a portion of its spinal marrow was in turn inoculated into a second rabbit, and so on until sixty rabbits had been inoculated. At each successive inoculation the virus became of increased potency, and the last period was not more than seven days. Having ascertained that exposure to dried air diminishes the virus, and consequently reduces its force, M. Pasteur supplied himself with a series of bottles containing dried air. In these bottles were placed portions of the inoculated spinal marrow of successive dates, the oldest being the least virulent, and the latest the most so. For an operation M. Pasteur begins by inoculating his subject with the oldest tissue, and finishes by injecting a piece dating from two days only, whose period of incubation would not exceed one week. The subject is then found to be absolutely proof against the disease. At the beginning of July a young Alsatian, named Joseph Meister, who had been severely bitten in several places by an undoubtedly rabid dog, presented himself at the laboratory. His case, left to itself, being considered hopeless by M. Pasteur, Prof. Vulpian, and other high authorities, the patient was submitted to the same series of inoculations that had been so successful on dogs. As a proof a series of rabbits were simultaneously subjected to the identical processes. In ten days thirteen inoculations were made with pieces of spinal marrow containing virus of constantly-increasing strength, the last being from the spine of a rabbit which had died only the day before. The youth thus operated upon by the successive administrations of weaker virus was made proof against the virus of the intensest strength. It is now 100 days since he underwent the last inoculation, and he is in perfect health. Those rabbits, on the contrary, which were at once inoculated with the strong virus, without first being rendered fit to receive it, became affected within the proper incubation period, and died with the usual symptoms. The first inoculation practised upon Meister was sixty hours after he had been bitten. M. Pasteur has, at the present moment, another human patient under treatment who was bitten a few days ago by a mad dog. M. Pasteur said it would now be necessary to provide an establishment where rabbits might always be kept inoculated with the disease. In this way there would constantly be a supply of spinal tissues, of both old and recent inoculation, ready for use. Before the sitting was adjourned M. Pasteur received an enthusiastic ovation from both the Academy and the public present.

The annual meeting of the five academies forming the French Institute took place at two o'clock on October 24 in the large hall of the Institut; M. Bouguereau, President of the Academy of Beaux Arts was in the chair. The great prize delivered once every two years was awarded to Dr. Brown-Sequard, the well-known physiologist. M. Paul Bert had written a paper "On Vivisection," which was expected as a sequel to the delivery of the prize to Dr. Brown-Sequard, but it was not read for want of time. The annual banquet took place in the evening for the second time.

It is rumoured that M. Goblet, the Minister of Public Instruction, proposes to return to the former organisation of the Institut, which was regarded as a universal self-electing body. Each class or special academy had not the privilege of choosing its own members as now, but of proposing a list of candidates to the whole Institut. The increased solemnity given to the annual and quarterly meetings, and the institution of banquets, are considered as preparatory to this important change.

M. Bertrand, who was nominated member of the French Academy some months ago, will be received on December 10 next, at a solemn sitting, when he will read his inaugural address. It will be answered by M. Pasteur.

A very valuable addition has recently been made to the Science Collections now displayed in the Western Galleries at the South Kensington Museum of Science and Art. Mr. Rochfort Connor, of the Inland Revenue Department, has prepared a number of exquisitely finished pen-and-ink drawings of objects viewed with the microscope, often by the aid of very high powers. The collection, which covers two large screens in the rooms devoted to biology and geology, include drawings of insects and other minute forms of animals, and of various anatomical preparations from them, of curiosities of pond-life, and of the skeletons of many organisms, both recent and fossil. Among these last Mr. Connor's highly-finished representation of some of the more complicated forms of the Diatomaceæ, such as *Heliopelta* and *Coscinodiscus*, are especially worthy of admiration, though some of his drawings of Foraminifera, Bryozoa, and Sponge-spicules are scarcely inferior to these in delicacy of execution. These drawings represent, we understand, the leisure hours of a busy life-time, and their author is now engaged in a series of microscopic drawings illustrating the characters of food-products and their adulterants. A few of these are now exhibited as samples, and the series when complete cannot fail to be of great use to public analysts and others.

At a meeting of the Brookville (U.S.) Society of Natural History, September 22 (according to *Science*), a committee was appointed to confer with the scientific associations, educational institutions, and with individuals throughout the State of Indiana, concerning the advisability of the formation of a State Academy of Science, and if thought advisable, to co-operate with such persons in favour of the formation of such an association. Free expression of opinion is called for by the committee, both as to the need of such an organisation and as to the best plan for its composition. It is now the plan to hold a meeting at Indianapolis between Christmas and New Year's day. It proposed that the organisation shall enable the citizens of Indiana who are engaged in scientific work to meet at certain times "for social intercourse, for the exchange of ideas, and the comparison of results of scientific studies." It would appear from the prospectus that the Academy would be a State society similar to the American Association.

Some theoretical views on the detonation of meteorites have been recently offered by Signor Bombicci in the Royal Accademia dei Lincei. He supposes the detonation to be that of an explosive gas mixture, formed during the surface-heating of the mass in the atmosphere, and accumulating chiefly in the vacuous space left behind the mass in its very swift flight. The gas mixture is probably of oxygen and hydrogen, and it becomes detonant when the proportions are near those in which the gases form water. The oxygen may be supplied from the air; the hydrogen may come from the meteorite itself, which, having like porous bodies and fused metals, taken it up and condensed it in some region of space, sets it free again as it becomes very hot by friction of the air, and as an enormous difference of pressure arises between the front and the back part. But a portion (and perhaps the larger) of the detonating mixture may come from dissociation of the aqueous vapour in contact with the glowing and fused surface of the meteor. To the idea of an actual explosion of the meteorite by internal energy, Signor Bombicci objects that the ball must be shattered to the finest dust, and that fragments would not be coated with a crust. Sometimes meteorite stones remain quite whole in spite of the detonation. Haidinger's idea of the sound being due to air rushing into the vacuum behind the meteorite is thought improbable because the detonation takes place in very high layers of the atmosphere, where the air is much too rare; moreover the movement of the meteorite until detonation is a quite steady one. The character of the noise, and its repetition at intervals, also the shattering of the mass into fragments forming a cone of dispersion towards the earth all agree, in the author's opinion, with an explosion of gas behind the meteorite. Referring to another point, Signor Bombicci thinks that the earth has by virtue of its magnetism a selective action on cosmic masses; hence the universal presence of iron in meteorites.

Messrs. A. and C. Black will publish immediately a volume by Dr. Croll, F.R.S., entitled "Discussions on Climate and Cosmology," and also a new edition of "Climate and Time."

According to the *Journal of Indian Art* the Government of India has decided to combine the duties of the Archæological Survey and those hitherto performed by the curator of Ancient Monuments. For this purpose India, exclusive of the Madras and Bombay presidencies, has been partitioned into three divisions, one of which has been placed under the control of Major Keith, who superintended the construction of the magnificent Gwalior gate which H.H. Maharajah Scindia has presented to the South Kensington Museum, and which will be a prominent ornament of next year's exhibition.

We have received from Mr. Saville Kent, Superintendent and Inspector of Fisheries in Tasmania, a very encouraging report of operations for the year ending July 31, 1885. Much of the report is devoted to oyster fisheries, which Mr. Kent is endeavouring to develop on scientific principles. He has established hatcheries at various points, and a laboratory for experiments, and under his care the oyster ought to become an important industrial product in Tasmania. He also advises the encouragement of sponge fisheries. With regard to Salmonidæ, Mr. Kent concludes that no true salmon have yet been established in the lakes and rivers of Tasmania. The fish of large size which abound in the great lakes and other large sheets of water are really essentially the same as the Great Lake Trout or *Salmo ferox* of Great Britain.

In the Report by the Board of Trade on their proceedings and business under the Weights and Measures Act for the past year, it is stated that the attention of the department has been called by the Corporation of Dublin to the necessity of providing a legal standard measure for testing steam pressure-gauges. In reference thereto regret has been expressed that at present the Standards Department has no power to do this. The question appears to be whether a pressure-gauge is a "measure" within the meaning of the Act. The testing apparatus proposed by the Corporation is a measurer of pressure applicable only for special use, and it belongs to a class of measuring instruments, as barometers, thermometers, &c., not directly provided for by the Act. In the report of last year an opinion was expressed that the time had now arrived when this country might, on proper conditions, join the International Convention on Metric Standards, and in September last Her Majesty's Government made known to the Comité International des Poids et Mesures at Paris that England was willing to join the Convention. This has now been done; and the Comité accepts the reservation of Her Majesty's Government as to the introduction of the metric system into this country, affirming that there is nothing in the articles of the Convention which implies any obligation on the part of a contracting State to attempt to modify the system of weights and measures legalised at the time in that State. The adhesion of England, therefore, is not to be regarded as an expression of opinion that the adoption of the metric system in this country would be desirable. A copy is attached to the Report of a Memorandum on Metric Standards intended for laboratory use; and also a copy of a scale of errors to be permitted on ordinary metric standards used in testing manufacturers' weights. Metric weights from 20 kilograms to one milligram, to be used for the purposes of science and manufacture, or for any lawful purpose not being for the purpose of trade, have been verified for the local authority of Birmingham.

Mr. Clement L. Wragge, of the Torrens Observatory, near Adelaide, late of Ben Nevis, has been instructed by the Queensland Government to "visit and report as to the best means of establishing meteorological stations in Queensland, including the Cape York Peninsula and Torres Straits." Mr. Wragge, who lately returned to Brisbane from Northern Queensland, will commence his duties early this month, and proceed shortly to Normanton in the Gulf of Carpentaria.

The Institution of Mechanical Engineers met at Coventry yesterday, when the following papers were read:—On the construction of modern cycles, by Mr. Robert Edward Phillips, of London; on the distribution of the wheel load in cycles, by Mr. J. Alfred Griffiths, of Coventry; description of a hydraulic buffer-stop for railways, by Mr. Alfred A. Langley, of Derby.

The aquarium at the Inventions Exhibition has lately received some valuable additions in the form of golden tench, American salmonidæ, and Italian carp, notwithstanding the fact that the Exhibition will shortly close. It is to be hoped that the exhibits from the Buckland Museum collection will be allowed to remain in the aquarium, where they appear to far better advantage than in their previous *locale*.

The Ichthyological Museum now in course of formation at South Kensington has been lately enriched with further valuable specimens of fish. Amongst them are some prawns unique in size, measuring *twelve* inches long, which were presented by Mr. John S. Charles, of Lower Grosvenor Square.

The *Scientific American*, in a recent issue, describes the tangent galvanometer constructed at Cornell University, from the designs of Mr. Anthony, the Professor of Physics, to meet the want of a standard instrument for the measurement of heavy currents, and for the direct calibration of the commercial instruments in use for measuring the currents employed in electric lighting, &c. For the measurement of heavy currents there are four circles, two 2 metres in diameter, and two 1·6 metres, mounted, according to Helmholtz's plan, at distances apart equal to their radii. The conductors forming these circles are copper rods, three fourths of an inch in diameter. The needle is suspended by a silk fibre in a [illegible] which serves as an effectual damper, and r[illegible] rapidly. By a peculia[illegible] the [illegible]ons are rea[illegible] 50 [illegible] diameter, t[illegible] The [illegible] conductors a[illegible] rately turned and adjusted, and the dimensions are all known within one five-thousandth. For the measurement of small currents there are two circles, about 1·5 metres diameter, each having two conductors, and comprising altogether 72 turns of No. 12 copper wire.

THE indications of such an instrument of course depend upon the value of the horizontal intensity of the earth's magnetism, and without some means of determining this quantity in the place where the instrument stands, and at the time when a measurement is being made, no great accuracy is attainable. For making this determination, a coil a metre in diameter, consisting of 100 turns of No. 18 wire, is suspended, so that its centre coincides with the centre of the instrument by means of a single phosphor-bronze wire, which is itself attached to a torsion-head reading to ten seconds of arc. By the aid of this coil, observations may be taken at any moment for the determination of H by the method proposed by Sir William Thomson. The instrument is mounted in a copper building, from the construction of which all iron has been rigidly excluded. Several conducting wires connect the building with the dynamo and other rooms of the physical laboratory, 550 feet distant, and switches in the building serve to send the currents through the several coils of the galvanometer singly, in series, or in multiple arc, direct or reversed. By this means currents from 1 milliampere to 250 amperes can be accurately measured.

THE last number (Heft 33) of the *Mittheilungen der Deutschen Gesellschaft für Natur und Volkerkunde Ostasiens* contains a paper by Herr Hütterott on the Japanese sword, with numerous illustrations of the various forms. It describes the manner in which it is forged, how it reaches the extraordinary degree of excellence for which it is celebrated, in short the *technique* of the making of a Japanese sword in the feudal days. Herr Mayet concludes his account of a visit to Corea, the first part of which we have already noticed. Dr. Naumann, the director of the Geological Survey of Japan, and Japanese representative at the late Geological Congress at Berlin, communicated an extract from a report of his on the geological structure of the Japanese islands.

ONE-TENTH of the "Studentenschaft" at the Zurich University is now female. Twenty-nine young ladies study medicine, fourteen philosophy, and two political economy. Of the forty-five female students, fifteen are Swiss, and ten Russian.

THE after-sunglow has again at times been visible in Stockholm, from the middle of August to the middle of September, being distinct from the ordinary evening aurora.

A FURTHER telegram has just been received by the Russian Minister of War from Col. Prjevalsky, dated Osh, September 30—that is, the 12th inst., new style. Only the concluding passage has as yet been published by the Russian papers:—"August 14 (new style, August 26), Oasis of Tchira.—I have explored the Keria Mountains. We are now proceeding *viâ* Khoten and Aksu, and we shall arrive in Semiretchia towards the end of October. All is well."

THE spheroidal [illegible] liquids has recently been made an object of study by S[illegible]ini (*Il Nuovo Cimento*). A curious phenomenon wa[illegible] air was blown into the drop (to test the view that l[illegible]ate do not boil because they have lost their disso[illegible]rose bubbles often larger than the mass of li[illegible]stent; they shared the [illegible] of the dr[illegible]oved independently. [illegible] water, alcohol, and [illegible] Sometimes they [illegible] Signor Luvini [illegible] their dissolved air, or lose it very little. The author made arrangements for observing the spheroidal state under different air pressures, and he came to the conclusion that the temperature of each liquid in that state, under a given pressure, is very nearly equal to the least boiling temperature of the liquid under the same pressure.

WE have just received from the secretary, Mr. Charles Bailey, F.L.S., of Manchester, the reports of the Botanical Exchange Club for the years 1883 and 1884. For 1883 Mr. G. Nicholson acted as distributor, and 3735 specimens were received and divided out again amongst the members. In 1884 Mr. Arthur Bennett undertook the labour of distribution, and the number of specimens placed in circulation was 4371. The two reports contain a series of annotations by the distributors upon the more interesting plants which passed through their hands. For a considerable number of species new counties are registered. The most interesting additions to the British flora, of which they make mention, are a *Scutellaria*, intermediate between *minor* and *galericulata*, perhaps a hybrid, found by Mr. Nicholson in a place one would have thought likely to be thoroughly explored long ago—the shores of Virginia Water; *Potamogeton fluitans*, a pond-weed very difficult to recognise, found by Mr. A. Fryer in Huntingdonshire; and *Carex salina*, a boreal species known already in Scandinavia, Iceland, the Faroes, Nova Zembla, and North America, which has lately been discovered by Mr. Grant in Caithness. The Rubi of Britain want carefully comparing with those of the Continent, and Mr Arthur Bennett has done well to send the Club specimens to be verified by Dr. Foche, of Bremen, whose synopsis of the German Rubi has been taken lately by Hyman as a basis for his enumeration of the European forms in his most useful geographical conspectus of the European flora.

A CURIOUS calculation has been recently made by Signor Bartoli regarding the mean density of a body which should contain all the known elements in a solid state, either uncombined, or, if partly combined, each retaining the density belonging to it in the solid state. The author makes three suppositions—(1) the masses of all the substances equal; (2) masses such that the corresponding volumes are equal; (3) masses in ratio of the atomic weights. The corresponding mean densities he arrives at are 2·698, 7·027, and 5·776, and it is pointed out that the last value comes very near that got by Cavendish for the mean density of the earth, viz. 5·67; possibly an accidental agreement, yet interesting.

WE have received from Mr. Francis Day copies of two papers, on a subject on which he also read a paper at the Aberdeen meeting of the British Association. One is entitled "Notes on the Breeding of Salmonidæ," being observations on the fish cultural experiments being carried on at Howietown, and on experiments by the author himself at Cheltenham. The second, from the *Transactions* of the Linnean Society, is on the breeding of salmon from parents which have never visited the sea. This also describes the results of experiments at Howietown.

WE have received the report of the Council of the Leicester Literary and Philosophical Society for the past year. Various important additions have been made to the town museum; the work on the flora of Leicestershire, undertaken and edited by a botanical sub-committee, is now in the press, and will shortly be published; the resolution, adopted at the last general meeting of the society, for the promotion of science classes in the town has, owing to various circumstances, only been partially carried out. Two experimental classes, one for pure mathematics, the other for physiology, have been commenced, and have been attended with fair results. The reports of the various sections show a considerable amount of work done during the year.

Short abstracts of various papers read before the society are given in the *Transactions*.

A MISSION of thirteen youths, belonging to the best families in Cambodia, has arrived in Paris for the purpose of study. They have been placed under the care of M. Pavie, who has constructed a line of telegraphs between Siam and Cambodia. This is the first time since 1864 that Cambodians have come abroad for purposes of education.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii* ♂) from South Africa, presented by Mr. George E. Crisp; a Malbrouck Monkey (*Cercopithecus cynosurus* ♂) from West Africa, presented by Miss Ethel O'Donoghue; a Kinkajou (*Cercoleptes caudivolvulus*) from Demerara, presented by Mr. John Carder; four Common Squirrels (*Sciurus vulgaris*), six Common Dormice (*Muscardinus avellanarius*), British, presented by Mr. Thomas Weddle; a Tennant's Squirrel (*Sciurus tennanti*) from Ceylon, presented by Miss Maude Bovill; two Vulpine Squirrels (*Sciurus vulpinus*) from North America, presented by Capt. E. E. Vaill; a Coypu (*Myopotamus coypus*) from South America, presented by Mrs. Amelia Appleton; a Robben Island Snake (*Coronella phocarum*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two Sly Silurus (*Silurus glanis*), European, presented by the Marquis of Bath, F.Z.S.; a Red Lory (*Eos rubra*) from Moluccas, an Alexandrine Parrakeet (*Palæornis alexandri*) from India, deposited.

## *OUR ASTRONOMICAL COLUMN*

PERIODICAL COMETS IN 1886.—Of the now somewhat numerous list of comets of short period, two will be due at perihelion in the ensuing year:—(1) The comet Tempel-Swift, or 1869 III. and 1880 IV., which is likely to return under circumstances that will render observations impracticable, so far at least as a judgment can be formed without actual calculation of the perturbations. (2) Winnecke's comet, last observed in 1875, its track in the heavens near the perihelion passage in December 1880 not allowing of the comet being seen at that return; the perturbations may be very sensible during the present revolution: neglecting their effect, the mean motion determined by Prof. Oppolzer, for 1880, would bring the comet to perihelion again about August 24·5, under which condition its path would be as follows:—

| | | R.A. | Decl. | Distance from Earth |
|---|---|---|---|---|
| July | 25·5 | 177·5 | +10·2 | 1·17 |
| Sept. | 13·5 | 241·7 | −24·9 | 0·98 |
| | 23·5 | 246·1 | −30·2 | 0·64 |
| Oct. | 3·5 | 264·8 | −35·6 | 0·64 |
| | 23·5 | 305·0 | −36·0 | 0·77 |

The actual orbit of Winnecke's comet approaches very near to that of the planet Jupiter in heliocentric longitude 110°, at which point the comet arrives 720 days or 1·97 years before perihelion passage, the distance between the two orbits is then less than 0·06 of the earth's mean distance from the sun.

It is very possible, however, that the comet which may most interest astronomers in 1886 will be that observed in 1815, and known as Olbers' comet, which, according to the elaborate calculations of Dr. Ginzel, will again arrive at perihelion in December 1886. The most probable date that can be inferred from the observations of 1815, and the computation of planetary perturbations in the interval is December 16, but unfortunately the observations did not suffice to determine the mean motion in 1815 with precision, and consequently Ginzel found for the limits of the period of revolution 72·33 and 75·68 years, hence the comet may reach its perihelion many months earlier or later than the date given by calculation. Extensive sweeping ephemerides have been published, and it may not be too soon to direct attention to a search for the comet at the beginning of the next year, or as soon as the region in which its orbit is projected at the time can be advantageously examined.

A CATALOGUE OF 1000 SOUTHERN STARS.—Vol. iii. of "Publications of the Washburn Observatory" is to contain a catalogue of 1000 stars between 18° and 30° of south declination, formed by Rev. Father Hagen and Prof. Holden from the observations of Prof. Tacchini at Palermo during the years 1867–69, which were printed in the *Bulletino* of that observatory between April, 1867, and July, 1869, and with which Prof. Holden says he became acquainted through M. Houzeau's Vade-Mecum. The stars observed are from the 6th to the [illegible] magnitudes, and the magnitudes appear to have been very carefully noted, while it is remarked that the positions are excellent. They are reduced to the year 1850, but the mean epoch of observation of each star is appended. The copy before us is a reprint from the above-named volume. Tacchini's observations were made with the Palermo meridian circle fully described in the *Bulletino*.

## *ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, NOVEMBER 1–7*

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on November 1*

Sun rises, 6h. 56m.; souths, 11h. 43m. 40·9s.; sets, 16h. 31m.; decl. on meridian, 14° 35′ S.: Sidereal Time at Sunset, 19h. 15m.

Moon (two days after Last Quarter) rises, 0h. 13m.; souths, 7h. 20m.; sets, 14h. 14m.; decl. on meridian, 9° 37′ N.

| Planet | Rises h. m. | Souths h. m. | Sets h. m. | Decl. on meridian ° ′ |
|---|---|---|---|---|
| Mercury | 7 57 | 12 22 | 16 47 | 18 25 S. |
| Venus | 11 11 | 14 46 | 18 21 | 25 50 S. |
| Mars | 23 54* | 7 13 | 14 32 | 14 20 N. |
| Jupiter | 2 55 | 9 9 | 15 23 | 2 2 N. |
| Saturn | 19 45* | 3 53 | 12 1 | 22 18 N. |

* Indicates that the rising is that of the preceding day.

*Phenomena of Jupiter's Satellites*

| Nov. | h. m. | | Nov. | h. m. | |
|---|---|---|---|---|---|
| 1 | 6 48 | II. occ. reap. | 6 | 5 18 | I. tr. egr. |
| 5 | 5 1 | I. ecl. disap. | 7 | 2 39 | I. occ. reap. |
| 6 | 3 0 | I. tr. ing. | | | |

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Saturn, Nov. 1.—Outer major axis of outer ring = 44″·0; outer minor axis of outer ring = 18″·9; southern surface visible.

| Nov. | h. | |
|---|---|---|
| 1 | 4 | Mars in conjunction with and 4° 16′ north of the Moon. |
| 3 | 7 | Mercury at greatest distance from the Sun. |
| 3 | 9 | Jupiter in conjunction with and 0° 52′ north of the Moon. |
| 7 | 21 | Mercury in conjunction with and 6° 16′ south of the Moon. |

## *THE SCOTTISH METEOROLOGICAL SOCIETY*

AT the annual meeting of this Society the Report of the Council stated that thirty-eight new members had been added to the Society during the year, and the membership now numbered 698. A new station had been established on the island of Fidra, at the mouth of the Firth of Forth, and that observations had been made for the Society at San George, Central Uruguay. A large number of naturalists and others had availed themselves of the facilities for research offered by the Scottish Marine Station during the summer, there being thirteen working at the laboratories at the present time. Communications were now going on between the Council and several influential gentlemen in Glasgow, which it was hoped would result in the establishment of a permanent station for marine research on the Clyde. Mr. H. N. Dickson, of the Marine Station, communicated the results of experiments and observations which, during the past two months, he had been conducting at Granton, with the view of collecting data from which to determine the corrections to be applied to the readings of thermometers exposed in the ordinary Stevenson screen, in use in many places over the world. Having referred to the errors to which the ordinary screen gives rise, consequent on the varying atmospheric [illegible] and radiation, he proceeded to say that [illegible] carried on chiefly by means of improv[illegible] John Aitken of Darroch and that [illegible] and wet bulbs by Glaisher's tables had been compared with those given by a new form of hygrometer designed by Prof. Chrystal of Edinburgh University. As regards Mr. Aitken's screen, in some a fan was introduced in order to secure a proper and uniform circulation of air for the thermometers in all weathers; others were simply sunshades; one consisted of two thermometers, one of which was partially blackened; and another of a thermometer having its bulb inclosed in a tight-fitting silver sheath, highly polished. The construction of Prof. Chrystal's hygrometer was explained and a brief account given of the results either already arrived at or suggested during the investigation, and it was intimated the inquiry was to be resumed at the Ben Nevis Observatory during August and September. At this Observatory, the climate of which offers unique facilities for the prosecution of such inquiries, an instrument of novel construction would be added, which had been designed by Prof. Tait for hygrometric research. Prof. Ewing, of Dundee, then described the arrangements which had been made for commencing the proposed earthquake observations on Ben Nevis this summer. The investigation was to include earthquakes proper; earth movements of so very delicate a kind as to be totally indistinguishable without some form of instrumental assistance, which are conveniently called earth tremors; and there were what might be named changes of the vertical, or those tiltings which the earth's surface seemed to be constantly undergoing. The different seismometers to be employed at the Observatory were then described, and in illustration some of the more striking peculiarities of the earthquakes of Japan were referred to.

## *PROF. KIESSLING'S INVESTIGATIONS INTO THE ORIGIN OF THE LATE SUNSET GLOWS*[1]

THE interesting and important experimental demonstrations lately made by Prof. Kiessling of Hamburg to illustrate the artificial formation of all manner of sunset effects are probably well known to meteorologists in general. The September number of *Das Wetter* contains a valuable series of comparisons tending to show that the conditions under which artificial glows were produced have actually existed whenever the remarkable sunset effects have made themselves prominent. The following abstract may prove of interest to those who do not receive the paper itself.

With regard to the "after-glow," or re-illumination, he suggests two explanations as possible:—(*a*) Simple reflection of the refracted rays essential to the formation of the ordinary sunset-glow (the *first* glow); or (*b*) direct diffraction by a second homogeneous haze at much greater elevation. He considers, however, that the calculated heights of the latter place it out of the question. To the former there are only two important objections, the chief one being the slight polarisation, so far as the very scanty records indicate. The observations are, however, exceedingly deficient. Still, Prof. Kiessling has to allow that they do not tell in favour of the proposed explanation. The other difficulty is the *position* of the glow. It presupposes a mirror-like surface, parallel to the earth, with the intermediate space unusually transparent, conditions at first sight very improbable at the altitudes under consideration. But Prof. Kiessling's own experiments, detailed at the end of his paper on "Die Dämmerungserscheinungen im Jahre 1883," have shown the possibility. In these he obtained results most remarkably similar to those requiring explanation, and by methods reproducing in a striking manner the conditions considered actually to exist in the atmosphere.

A warm, moist stratum of air being produced in contact with a cold stratum the resulting haze along the contact surface formed the site of diffraction phenomena, approaching those actually observed in ordinary brilliant sunsets according to the fineness of the haze particles, and also reflections reproducing the "after-glow."

The almost constant saturation of the cold upper strata in winter is indicated by observations at high-level stations and the persistent upper haze. Let a warm [cyclonic] current come beneath such a layer, then the fine haze at the surface of contact will have beneath it the peculiarly transparent atmosphere common to [illegible] conditi[illegible] requisite for the transmission of the resulting diffraction (and reflection) phenomena. This should be found to exist in *all* brilliant sunsets, Prof. Kiessling stating the following law:—*An intense purple glow, visible over a considerable area, may occur when, in close proximity beneath a lofty and highly-attenuated haze, there is formed an extensive stratum of air at considerably higher temperature.*

| Date of Sunset | Date of Observation (Roman Figures) and Difference of Temperature | | | | | | |
|---|---|---|---|---|---|---|---|
| January 30, 1883 | XXVIII. − 3·6 | XXIX. + 2·7 | XXX. + 4·3 | XXXI. − 2·6 | | | |
| February 11 | X. − 2·0 | XI. + 3·2 | XII. + 0·1 | XIII. + 6·1 | XIV. + 0·5 | | |
| April 27 (at Grachen) and 28 | XXV. − 4·9 | XXVI. − 2·1 | XXVII. + 1·2 | XXVIII. + 2·9 | XXIX. + 0·7 | | |
| May 5 (warmer season) | III. − 3·4 | IV. − 1·7 | V. − 4·5 | VI. − 4·1 | VII. − 2·5 | | |
| But on Rigi (1790 metres) | − 10·4 | − 8·8 | − 7·7 | − 8·5 | − 8·6 | | |
| Santis (2467 metres) | − 14·1 | − 13·4 | − 13·1 | − 11·3 | − 12·1 | | |
| St. Bernard (2400 metres, about) | − 14·7 | − 14·4 | − 13·6 | − 13·6 | − 11·4 | | |
| September 20 | XVIII. − 3·8 | XIX. − 0·9 | XX. + 5·5 | XXI. − 2·0 | XXII. − 0·2 | | |
| Rigi Culm | − 7·6 | − 5·7 | + 1·2 | − 6·5 | − 7·0 | | |
| October 9 (Grachen) and 11 | VII. − 1·9 | VIII. + 1·4 | IX. + 0·3 | X. + 1·7 | XI. + 6·5 | XII. + 2·0 | XIII. − 1·5 |
| November 22 and 23 | XXI. + 0·6 | XXII. + 1·6 | XXIII. + 4·4 | XXIV. − 2·5 | | | |
| November 29 and 30 | XXVII. + 0·8 | XXVIII. − 2·6 | XXIX. − 1·6 | XXX. + 2·6 | I. + 5·2 | II. − 2·4 | |
| Rigi } glows generally over | − 4·5 | − 6·9 | − 0·8 | + 3·7 | + 3·5 | − 6·3 | |
| Santis } Europe. | − 7·5 | − 9·9 | − 4·2 | + 2·3 | − 0·7 | − 9·7 | |
| Pic du Midi (2859 metres) | − 13·3 | − 7·2 | + 0·8 | + 3·8 | − 2·8 | − 13·3 | |

Although we cannot ever expect direct observations of temperature at the common surface producing the sunset glows, yet, as Prof. Kiessling shows, if we can prove that the warm undercurrent always accompanies sunset glows, the proof is practically complete. Such indications may be expected during the colder seasons in the form of abnormal vertical distribution of tempera-

[1] "Ueber [illegible] ...sen Purpurlichtes und die Abhängigkeit [illegible] Temperatur, und Feuchtigkeit der Luft [illegible]"

ture, an *increase* instead of decrease at higher stations. He brings forward a long array of figures supporting this conclusion, especially for sunrise effects in 1883, as seen from Santis (2467 metres), in North-East Switzerland, in the bend of the Rhine. Stations to the east—Munich (528 metres) and Hohen Peissenberg (994 metres) are taken for observations on temperature and relative humidity. The last place is about 35 miles south-west of Munich; both may be considered as beneath the sky region producing glows at Santis. As *difference of temperature* is the most decisive comparison, his tables are here reduced to a series showing the difference of Hohen Peissenberg returns from Munich, in degrees Centigrade. In some cases one or two other returns are also added, reduced in like manner. *Normally*, allowing for difference of height, Hohen Peissenberg should register 2°·5 below Munich.

The final set of observations refer to some of the earlier afterglows. The greater anomaly with greater elevation (increases of 5°·2, 10°·6, 12°·2, and 17°·1 respectively in the figures given) is very suggestive. The reason of the non-agreement in May has already been stated.

Except the last, these observations refer to ordinary sunrise effects, but the only difference between them and the recent glows is considered to be that the latter occur by reflection at a higher level and in a more finely attenuated haze, thus giving the richer effects. The presence of such a haze with the glows was a matter of very common observation.

The question, of course, requires further consideration, especially with respect to observations of the recent glows. Besides this connection with a warm stratum of air, Prof. Kiessling finds another, almost as general, with barometric maxima, as was noticed with the similar phenomena in 1881.

Referring, in his concluding paragraph, to the connection of the glows with the Krakatoa eruption, Prof. Kiessling writes that the thousand or so records of their geographical distribution, now in his hands, "show a perfectly continuous spread of the anomalous glows, and of the diffraction phenomena of Bishop's Ring dating from August 26, 1883, and spreading from the Straits of Sunda as a centre over the tropical and temperate zones."

J. EDMUND CLARK

## *A CENTURY OF SCIENCE IN BENGAL*

IT was a happy idea of the Council of the Asiatic Society of Bengal to commemorate the completion of a century of the Society's existence by publishing a review of the progress made and the services rendered to knowledge by the institution.[1] The idea of a learned society composed of Europeans in India studying the country and communicating to each other at periodical meetings the results of their researches, arose first in the fertile brain of Sir William Jones, who was judge in the Supreme Court at Fort William, and who delivered, on January 15, 1784, to about thirty members of the European community of Calcutta, a "Discourse on the Institution of a Society for Inquiring into the History, Civil and Natural, the Antiquities, Arts, Sciences, and Literature of Asia." As a result of this discourse, the "Asiatick Society," the parent of all such societies, was founded. Its motto, which is taken from Sir William Jones's discourse here referred to, is this: "The bounds of its investigations will be the geographical limits of Asia, and within these limits its inquiries will be extended to whatever is performed by man or produced by nature." After many vicissitudes it has just completed its hundredth year, and the record of its work forms the large volume just mentioned. This is divided into three parts: first, a history of the Society, by Dr. Mitra; its work in archæology, history, and literature, by Dr. Hœrnle; and the work in natural science, by Baboo P. N. Bose. The change which has come over the face of India in the course of a century could hardly be better marked than by the fact that two out of the three parts into which the volume is divided—one of these being on natural science—are written by native gentlemen. In the history of the Society we notice that in 1808 a resolution was proposed by Dr. Hare and seconded by Dr. Leyden (frequently referred to in Lockhart's "Life of Scott"), "that a Committee be appointed for the purpose of physical investigations, the collection of facts, ...mens, and correspondence with individuals whose situations ...ountry may be favourable for such discussions and in...ns." It was then agreed to provide two committees—one for science, the other for literature; twenty years later, in 1828, a committee was appointed "to promote geological researches, working under the rules then in force for the Physical Committee," and at the same time the published *Transactions* of the Society were divided into two parts, one devoted to physics, the other to literary subjects. Nearly twenty years later the whole of the work of the Society was delegated to six committees, one having charge of zoology and natural history, another of geology and mineralogy, and a third of meteorology and physics. The establishment of a museum did not occur to the founder, but curiosities were constantly coming in from members, and in 1796 it was proposed to give these a suitable house. In 1814 Dr. Wallich proposed the formation of a museum, and offered duplicates from his own collections, as well as his services in arranging it, and a museum was accordingly started. The story of the growth of the various sections of the Natural History Museum is told by Dr. Mitra. On the whole it is one of great progress, although financial difficulties beset the museum at first. But as soon as the Society became able to pay for scientific curators all went well. In 1865 the Society's zoological, geological, and archæological collections were made over to the Government of India for the public museum in Calcutta. A writer in the *Calcutta Review*, speaking of the Society's exertions for the establishment of the national museum, said: "Had it done nothing else to promote science during the last ten years, it would have entitled itself to the gratitude of posterity for the vigour with which it has prosecuted to success a project fraught with so much general usefulness." The earlier volumes of the Society's *Transactions*, published under the title "Asiatick Researches," created a sensation in the literary and scientific world in Europe. A French translation was speedily published, with notes on the scientific portions by no lesser hands than Cuvier, Lamarck, Delambre, and Olivier. Of the work of the Society in preserving Sanskrit MSS., in translating and publishing various works from the native languages, and other valuable services to literature, Dr. Mitra speaks at length. Amongst the publications, apart from the papers, we notice many of scientific interest, such as catalogues of various sections of the museum, of the mammals and birds of Burmah, of Indian lepidoptera, besides translations of numerous works of Hindoo science. In summing up at the conclusion of his historical sketch the benefits conferred on India and the world by the Society during its hundred years of existence, Dr. Mitra sums up its scientific work (apart from papers and published volumes above referred to) thus: "It got up an archæological and ethnological museum of considerable extent, a geological museum rich in meteorites and Indian fossils, and a zoological museum all but complete as regards the avifauna of India."

The long review of the work of the Society in natural science is, as already mentioned, written by Baboo Bose. His method is to take the various branches of science in succession, such as mathematical and physical science, geology, zoology, botany, geography, ethnology, and chemistry, and to describe under sub-heads the papers on these subjects contributed to the *Transactions* of the Society, together with a brief biographical sketch of the more celebrated or prolific authors. At the end we get a classified index of all the scientific papers, an alphabetical list according to the author's names being given at the conclusion of the first part. Amongst the latter we notice many whose names are familiar as contributors to NATURE. In the early years of the Society, and down to 1828, the scientific contributions to the Society's *Proceedings* were almost wholly connected with some branch of pure or mixed mathematics, for most of the men who went out to India, especially in the scientific branches of the military service, had been well grounded in this subject. The section on the investigations into the mathematical science of the Hindoos is of great interest. Sir William Jones put before the Society from the outset the object of studying these sciences, and he set the example himself, but the initial difficulty was to find any native capable of assisting him. Baboo Bose records that, although ample stipends were offered by Sir William Jones to any Hindoo astronomer who could name in Sanskrit all the constellations which he would point out, and to any Hindoo physician who could bring him all the plants mentioned in Sanskrit books, he was assured by the Brahmans whom he had commissioned to search for such instructors, that no Pundit in Bengal even pretended to possess the knowledge he required. Geology and mineralogy flourished in the Society from the commencement, while zoology was at first unduly depressed and discouraged owing

[1] "...mary Review of the Asiatic Society of Bengal, 1784 to 1883." ...by the Society, Calcutta. Thacker, Spink, and Co., 1885.

to the aversion of Sir William Jones to zoological studies, and it was only about 1828 that the papers of Dr. Falconer, Col. Tickell, and others began to occupy an important position on behalf of zoology in the Society's transactions. With Indian botany, geography, and ethnology are connected many names of world-wide fame. With regard to chemistry, it may be said practically there is no chemical research in the Society's publications. Chemistry, as Baboo Bose explains, can only be studied in the laboratory, and until recently India had but few laboratories, and few competent men with leisure to devote to the subject. A curious statement, by the way, creeps into the account of Mr. Piddington, who studied Indian storms, and gave an account of every cyclone in the East between 1839 and 1851. Baboo Bose says his experience was most varied, and then quotes the following from some unnamed source :—"He was one of the few who escaped from the massacre of Amboyna." Now, as the massacre of Englishmen by the Dutch Governor of Amboyna took place in 1622, Mr. Piddington, if he was observing storms in India in 1850, could hardly have been in the Eastern Archipelago two centuries and a quarter previously. Many other portions of this volume, such as the chapters on coins, on ancient Indian alphabets, on the study of the languages and literature of India, and on the study of Indian antiquities, are of deep interest, but we have confined ourselves to the chapters on natural science.

The dominant feeling produced by an examination of this volume is one of satisfaction that so much has been done by this single society towards investigating the past and the present of (or, in the words of Sir William Jones, "man and nature in") our great dependency. For the most part this has been done by private individuals, but on more than one critical occasion the directors of the East India Company, in accordance with their generous traditions, came to the aid of the Society with large contributions; otherwise there appeared no way out of the difficulty except the dissolution of the Society and the abandonment of the works in which they were engaged. If this were the place it would be interesting to compare this method of practically leaving everything to private initiative, with that adopted by the French in Indo-China, of the Government undertaking a series of literary, artistic, and scientific investigations through competent specialists into a new possession. Notwithstanding the great and marked success of the Asiatic Society of Bengal, the French plan has advantages which cannot be overlooked.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE*

CAMBRIDGE.—Among the more noticeable Natural Science Courses this term are Prof. Dewar's on Dissociation and Thermal Chemistry; Prof. Newton's, on Evolution in the Animal Kingdom; Dr. Gadow's on Human Embryology; Dr. Vines's, on the Physiology of Plants; and Prof. Macalister's, on the Peripheral Nervous System.

Prof. Hughes is lecturing on Methods of Geological Surveying; Dr. R. D. Roberts, on Principles of Geology; Mr. Marr, on Elementary Stratigraphy; Mr. T. Roberts, on Palæontology; and Mr. Hawker, on Elementary Petrology; all at the Woodwardian Museum.

Prof. Roy is lecturing on General Pathology, and also conducting a Practical Course in Morbid Anatomy and Histology.

Prof Stokes is lecturing on Hydrodynamics; Prof. Cayley, on Higher Algebra; Prof. Darwin, on Orbits and Perturbations; Mr. Glazebrook, on Waves and Sound; Mr. Hobson, on Planetary Theory; Mr. Macaulay, on Theory of Structures; and Mr. Forsyth on Abel's Theorem. Numerous other courses on higher mathematics, open to the University, are being given by college lecturers.

We are glad to notice that Mr. A. Sheridan Lea, M.A., Lecturer on Physiology, and formerly Scholar, of Trinity College, has been elected to a Fellowship at Gonville and Caius College. Mr. Lea's work in connection with Prof. Michael Foster's "Text-Book of Physiology" is well known. Mr. Lea was placed in the First Class in the Natural Science Tripos in 1875, and has since been continuously engaged in the University teaching of Physiology.

Dr. S. Richemann has been appointed assistant to Prof. Dewar, Jacksonian Professor.

Messrs. E. W. Hobson and A. R. Forsyth are appointed Moderators, and Mr. C. H. Prior Examiner, for the next Mathematical Tripos.

King's College offers a Vintner Exhibition of 70*l.* per annum for Natural Science. The examination begins on December 10.

St. John's College offers several scholarships, exhibitions, and sizarships for competition on December 10. Candidates may offer any of the subjects of the Natural Sciences Tripos except Mineralogy, and may be elected on the ground of special proficiency in one only. Particulars will be furnished by the tutors.

A joint examination for Natural Science Scholarships at Emmanuel, Christ's, and Sidney Sussex Colleges will be held on January 5, 1886, and following days. The subjects are Chemistry, Physics, Elementary Biology, Geology, and Mineralogy. Further particulars will be given by the tutors of either college.

Out of the 875 freshmen whose names have appeared in the preliminary lists, about 104 have announced their intention of studying medicine in the University. A few more may be added when the results of the October Previous Examination are known. The Anatomy School is attended by over 130 students, for whom an exceptionally abundant supply of dissecting material is in hand. The Demonstration Lectures have to be repeated from lack of room; indeed, the necessity for increased accommodation in this department is becoming extremely urgent.

LONDON.—We have received a circular stating that "In view of the adjourned extraordinary meeting of Convocation (of London University) to be held on Tuesday, November 3, a number of graduates met on Wednesday last to consider the proposed scheme for the establishment of a Teaching University for London. As the result of their deliberations it was thought desirable that attention should be called to some of the more striking objections to the proposed scheme; and that, having regard to the grave importance of the questions to be submitted to the members of Convocation affecting the very existence of the University as at present constituted, they should be especially requested to attend on Tuesday next, and to give their support to Mr. Bone's amendment, to *receive* the report submitted by Lord Justice Fry, without *adopting it* '*in bloc.*' Should this amendment be carried, the following resolutions, expressing what is believed to be the feeling of the majority of the graduates, will be moved :—(1) 'That Convocation, whilst affirming the general principles of the desirableness of bringing the teachers and the examiners of the University into closer relationship with one another and with the Senate, and of modifying the constitution of the Senate in accordance with the previous recommendations of Convocation, and without giving to the teachers an undue share of representation on the governing body of the University, refers back the scheme to the Special Committee for further consideration.' (2) 'That the number of members on the Special Committee be increased by one-half.'"

## *SOCIETIES AND ACADEMIES*

### SYDNEY

**Linnean Society of New South Wales**, July 29.—The following papers were read :—A monograph of the Australian sponges, part 5, the Auleninæ, by R. von Lendenfeld, Ph.D. Several sponges from various localities in the Australian region have been included by the author in this new sub-family, the members of which are characterised by a very peculiar structure not met with in any other sponges. The new sub-family *Aulenina* is placed in the family Spongidæ, and consists of the two new genera Aulena and Halme, with three species in all. The anatomy and histology of these is accurately described and illustrated by numerous plates. The Auleninæ form honeycombed or complicated reticulate structures; the cavities form a kind of vestibule and are simple in Halme, where an outer lamella surrounds the whole sponge, or subdivided into numerous small compartments, as in Aulena, where no outer lamella exists. Into the system of Vestibule-Lacunæ both the inhalent and the exhalent canals of the sponge open. The skeleton of Halme is composed of thick main fibres rich in sand, thin, simple and clean connecting fibres, and a hard cortex of sand cemented with spongiolin. The skeleton of Aulena is very peculiar. It consists of a regular network of fine horny threads in the joining points of which large sand grains are found. In the membranes of the Vestibule-Lacunæ of this genus nervous elements, sensitive and ganglia cells have been discovered by the author. These and many other histological details are described in the paper, which dwells also on the morphological significance of these interesting new sponges.—On a sponge destructive to oyster-culture in the Clarence River, by R. von Lendenfeld, Ph.D. In this paper the author describes a new sponge, *Chalinula coxii*, which appeared some years ago on certain oyster beds in the Clarence River, and destroyed some of them completely.—Note on the Glacial period in Australia, by R. von Lendenfeld, Ph.D. The author draws attention to some further evidence of ice action in the Mount Lofty group near Adelaide, where some glacier-polished Siluro-Devonian rocks, with very well preserved striæ, have been discovered and photographed.—Jottings from the biological laboratory of Sydney University, by William A. Haswell, M.A., B.Sc., F.L.S., &c., Lecturer on Zoology and Comparative Anatomy. This paper contains (1) some notes on an Australian species of Bonellia, which seems scarcely to differ from the European species, *Bonellia viridis*; and (2) some observations on aquatic respiration in fresh-water turtles.—On the supposed Glacial epoch in Australia, by Capt. F. W. Hutton, F.G.S., &c. The author discusses the phenomena which have been adduced as evidence for the former existence of a Glacial epoch in Australia, and shows that they are susceptible of a different interpretation. He distinguishes between a Glacier epoch, such as has occurred in New Zealand, in which, owing to various local, but only local, causes, ice-fields prevailed over much larger districts than at present, and a Glacial epoch, such as has been demonstrated in the Northern Hemisphere, which is the result not of variations caused and limited by local circumstances, but of alterations universal or cosmical in character. The Glacier epoch in New Zealand is regarded as anterior to the Glacial epoch of the North.

PARIS

**Academy of Sciences**, October 19.—M. Bouley, President, in the chair.—Remarks on the 209th volume of the "Connaissance des Temps" for the year 1881, presented to the Academy on behalf of the Bureau des Longitudes, by M. Faye.—Note on the establishment of a laboratory in the Institute for the measurement of the photographic plates obtained during the transit of Venus in 1882, by M. Bouquet de la Grye. Arrangements have been made, by means of which it is hoped that the calculations and measurements relating to 700 plates will be completed in fifteen months.—Note on the Dinoceratidæ discovered by Mr. Marsh in the Eocene formations of Wyoming, United States, by M. Albert Gaudry. These huge pachyderms, which seem most to resemble the European Coryphodon described by M. Hebert, are specially remarkable for the characteristic horny protuberances on the frontal region, whence their name (δεινός, terrible, and κέρας, horn). The skull is also distinguished by its small size, in this respect resembling that of a reptile, as well as of several other mammals of the Lower Tertiary epoch.—On the birational geometrical transformations of the *n* order, by M. de Jonquières.—Note on the fifth part of the topographical map of Algeria, presented to the Academy on behalf of the Minister of War, by Col. Perrier. This part comprises the six divisions of Jebel Edough, Bone, Wed-Guergur with Cape Rosa, Menerville, Medeah and Mostaganem to the scale of 1 : 50,000.—Note on the sub-lacustrine ravines of glacial streams, by M. F. A. Forel. During his recent surveys of Lakes Constance and Geneva, M. Hornlimann has discovered that both the Rhine and the Rhone continue their course under the lacustrine waters through deep ravines excavated beneath the respective submerged deltas. That of the Rhine has been traced for a distance of four kilometres and to a depth of 125 metres below the lake, while that of the Rhone may be followed for over six kilometres from the mouth of the river with a depth varying from 200 to 230 metres.—On the origin and classification of meteorites, by M. Stanislas Meunier. The author discusses the objections urged against his views on the nature and classification of meteoric bodies, by M. Brezina in the "Meteoritensammlung des Mineralogischen Hofkabinets in Wien," Vienna, 1885.—On the latitude of the observatory of Bordeaux, by M. G. Rayet. The mean latitude of this establishment, whose longitude was determined in 1881 at 11m. 26·44s. W., is found to be 44° 50′ 7″·23.—On the integrals of total differentials of the second species, by M. E. Picard.—Questions relating to a bundle of plane cubic figures, by M. P. H. Schoute.—On the torsion of prisms, by M. Marcel Brillouin.—Description of a new apparatus for measuring electric currents (one illustration), by M. F. de Lalande. This apparatus, ... "electric areometer" is proposed ... magnet, the source of so much error ... highly sensitive and practically unaffected ... ture, while its readings are unmodified by ... metallic bodies or even of powerful magnets ... the transmitting electromagnetic telephone ... —Note on the electrolysis of the salts, by ... Combination of the neutral carbonate of ... carbonate of potassa, by M. R. Engel.—On ... olive oil intended for consumption by ... cotton and other oils extracted from ... doynaud. The bichromate of potassa ... are proposed as reagents for determining ... substances.—On certain peculiarities in the ... teeth of the cachalot (spermaceti whale), by ... On the process of development of ... Beauregard.—On the part supposed to be ... tissues of wood in the ascension of the ... M. J. Vesque. The author contests the opinion ... logists who hold that it is impossible to ... purely physical forces the ascension of ... to metres high.—On a waterspout observed ... August 21, by M. Martial.—Account of the ... by M. Marc Dechevrens.—Description of ... rifle, by Gen. Favé. For this weapon ... it can be fired from five to ten times ... charging the enemy without stopping ... many as a hundred rounds may be fired ...

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## Diary of Societies

LONDON

*SATURDAY*, OCTOBER 31.

SEX FIELD CLUB, at 6.30.—Mosses and their Allies, with Special Reference to those of Essex: Prof. Boulger.—Exhibition of Stone Implements from Braintree, Essex: Rev. J. W. Kenworthy, M.A.

*SUNDAY*, NOVEMBER 1.

NDAY LECTURE SOCIETY, at 4.—The Poetry of Science: Miss Catherine A. Raison.

*MONDAY*, NOVEMBER 2.

OYAL INSTITUTION, at 5.—General Monthly Meeting.

*TUESDAY*, NOVEMBER 3.

OLOGICAL SOCIETY, at 8.30.—Descriptions of the Phytophagous Coleoptera of Japan obtained by Mr. George Lewis during his second Journey, 1880-81. Part II. Halticinæ and Galerucinæ: Martin Jacoby.—An Account of Two Collections of Lepidoptera recently received from Somaliland: A. G. Butler.—Description of a Tooth of Mastodon latidens from Borneo: R. Lydekker.—A Monograph of the Genus Paradoxurus, F. Cuv.: W. T. Blanford, F.R.S.—Description of a new Species of Mus from Sind. (Communicated by Mr. W. T. Blanford): J. A. Murray.—On the Specific Characters and Structure of some New Zealand Lumbricidæ: F. E. Beddard.

*WEDNESDAY*, NOVEMBER 4

EOLOGICAL SOCIETY, at 8.—On the Premaxillaries and Scalpriform Teeth of a Large Extinct Wombat (Phascolomys curvirostris, Ow.): Sir Richard Owen, K.C.B., F.R.S.—On the Structure and Classificatory Position of some Secondary Madreporaria: Prof. P. Martin Duncan, F.R.S.—On some Points in the Morphology of the Astrocœniæ of the Sutton Stone in the Infra-Lias of South Wales: Prof. P. Martin Duncan, F.R.S.

*THURSDAY*, NOVEMBER 5.

LINNEAN SOCIETY, at 8.—Flora of the Peruvian Andes, and its History and Origin: John Ball.—Monograph of Recent Brachiopoda, Part I.: The late Dr. Thomas Davidson.

CHEMICAL SOCIETY, at 8.—The Influence of Silicon on the Properties of Cast Iron. Part II.: Thomas Turner.—Modification of Double Sulphates: S. N. Pickering, M.A.—The Relation of Diazobenzene-anilide to Amidoazo-benzene; R. J. Friswell and A. G. Green.—The Phenol Constituents of Blast Furnace Tar from the Gartsherrie Iron Works: Watson Smith, J. F. H. Coutts, and H. E. Brothers.—The First Step in the Decomposition of Potassium Chlorate: F. L. Teed.

*FRIDAY*, NOVEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—The Carboniferous Rocks of Britain: W. Topley.

nted by RICHARD CLAY AND SONS, at 7 and 8, Bread Street Hill, Queen Victoria Street, in the City of Lo
MACMILLAN AND CO. at the Office, 29 and 30 Bedford, Street, Covent Garden—THURSDAY, October